FINAL REPORT

Environmental Registration for the Proposed Alton Natural Gas Storage Project

ALTON NATURAL GAS STORAGE LP

PROJECT NO. 1012229.

REPORT NO. 1012229.

FINAL REPORT TO	**Alton Natural Gas Storage LP** **PO Box 36052** **Halifax, NS** **B3J 3S9**
FOR	**Environmental Registration**
ON	**Proposed Alton Natural Gas Storage Project**

June 14, 2007

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EXECUTIVE SUMMARY

Alton Natural Gas Storage Limited Partnership (Alton, the Proponent) proposes developing an underground hydrocarbon storage facility in a series of engineered salt caverns near Alton, Nova Scotia (the Project). The proposed Project is initially intended to help manage the supply of natural gas in eastern Canada and the United States and may also be used for the storage of other hydrocarbons. The Project will consist of multiple caverns developed by solution mining in underground salt deposits. Solution mining is the process where water is used to dissolve salt deposits to form caverns, which then can be used as storage facilities. These salt deposits are natural geological formations located at depths of over 700 m. The caverns and their accompanying facilities will be capable of storing billions of cubic feet of natural gas produced during peak production/low demand periods and delivering it back to the gas pipeline system during periods of supply deficits. Salt cavern natural gas storage has been used extensively in North America for approximately five decades.

Key Project features include:

- buried pipelines from the area overlaying the salt formation to the Shubenacadie Estuary (the Estuary), at a distance of approximately 12 km, where water will be drawn to the facility near Alton with diluted brine returned to the Estuary during the cavern development process; and
- an underground natural gas storage facility in engineered salt caverns near Alton, Nova Scotia.

Initially, four caverns of approximately 226,000 m^3 (60 m diameter by 80 m in height) will be formed over 18 to 24 months, with construction commencing in the fall of 2007. Depending on future market demand, the Project may develop as many as 10 to 15 caverns at a later date. If so, brining and gas storage operations may operate concurrently as additional caverns are developed.

The caverns will be developed in accordance with the requirements of the latest edition of Canadian Standards Association (CSA) Standard Z341, *Storage of Hydrocarbons in Underground Formations*, which are among the highest safety standards in the world and will ensure the safe development and operation of these underground storage facilities. Under the adherence of these safety standards, there has never been a significant safety event involving facilities developed and in use in Canada.

Water for solution mining and dilution will be drawn from the Estuary. Alton designed the proposed method of discharge so that the brine is diluted by pumped estuary water prior to being discharged into the Estuary. This will be accomplished by a holding pond and mixing pond which will be used to hold brine, dilute brine with estuary water and control the discharge back to the Estuary. The diluted brine will be discharged around high tide to minimize the difference in salinity between the effluent and the receiving water body and to maximize the potential for mixing. Modeling results indicate that the salinity of the diluted brine discharged into the Estuary will be within the range of salinities that are normally experienced in the Estuary. This, as well as using relatively small amounts of water, compared to overall flow at the intake site, will minimize any potential impact on the aquatic environment.

Environmental assessment (EA) in Nova Scotia is regulated under the province's *Environment Act* and Environmental Assessment Regulations. The Project requires registration under the provincial environmental assessment process as a Class I Undertaking because it meets the following criteria:

- A facility engaged in the production, wholesale storage or wholesale distribution of dangerous goods.
- A storage facility with a total capacity of over 5000 m^3 intended to hold liquid or gaseous substances including, but not limited to, hydrocarbons or chemicals, but excluding water.

This report describes and evaluates the potential environmental and socio-economic effects of the Project during all Project phases. The evaluation has included proposed mitigative measures, where required, to reduce or eliminate potential significant impacts arising from Project-related activities. The report is based on information collected during field surveys, modeling, consultation with government and non-government agencies and individuals, background research and professional judgment of the Study Team.

A scoping process was undertaken to identify the Valued Environmental Components (VECs) and Valued Socio-economic Components (VSCs) most appropriate for this assessment. This scoping included: regulator and stakeholder consultation; regulatory issues and guidelines; research; and professional judgment.

The following VECs and VSCs were selected for the assessment:

- Fish and Fish Habitat;
- Rare and Sensitive Flora;
- Wildlife and Wildlife Habitat;
- Land and Resource Use;
- Labour and Economy;
- Fisheries Resources;
- Traditional Land and Resource Use; and
- Archaeological and Heritage Resources.

Each of the VEC/VSCs selected for the assessment was evaluated for potential interactions between the VEC/VSC and Project activities during all Project phases (*i.e.*, construction, operation and maintenance). Malfunctions and accidental events that may occur were assessed separately. These interactions were evaluated for potential significance after application of technically and economically feasible mitigative measures, where appropriate, to reduce or eliminate potential adverse Project-related environmental effects. Environmental monitoring and follow-up measures will be undertaken, where necessary, to ensure compliance with applicable regulations, standards, and guidelines, as well as to verify impact predictions and refine mitigative measures, where required.

Consultation with stakeholders, the general public and regulatory agencies is an important component of the assessment process. Consultation is directed at providing information to and obtaining feedback on the Project, particularly the location, design, construction and operations and maintenance procedures. Public involvement for the Project thus far includes:

- meetings with regulatory agencies;
- public announcements and solicitation of comments through a website and e-mail address;
- meetings with potentially affected landowners and other stakeholders;
- input from Aboriginal peoples; and
- open house sessions.

Consultation will continue as the Project proceeds through the approvals process, as well as through the planning, construction, and operations phases.

Extensive and thorough evaluation of potential effects that the brining system and storage facilities may have on the physical and socio-economic environment has indicated that the Alton Natural Gas Storage Project is not likely to have significant adverse effects on the environment. Adverse environmental effects will be reduced to acceptable levels through the use of technically and economically feasible design and mitigative measures. Positive effects from the Project are likely, particularly those related to increased economic activity and are described below.

Development of the Project will create a number of direct and indirect benefits for the Nova Scotian and Canadian economy. Projected costs of initially developing the facility to a capacity of 4 billion cubic feet of gas storage are estimated at $60 million, to be expended over the next several years. Furthermore, Alton is committed to using local resources where possible to ensure maximum benefit to Nova Scotians, particular residents of Colchester County.

It is anticipated that during construction of brining facilities, water pipelines and drilling four cavern wells, approximately 25 full-time equivalent positions will be created over the four-month construction period. At the peak of construction of brining facilities, water pipelines and drilling four cavern wells, the number employed will reach approximately 38. During construction of the gas storage surface facilities and pipelines, approximately 20 full-time equivalent positions will be created on average over the six-month construction period. At the peak of construction of the gas storage surface facilities and pipelines, the number employed will reach approximately 25.

During gas storage operation, it is anticipated that five to ten full-time equivalent positions will be required. This will include two or three office staff (to be located in Halifax), two full time gas plant technicians, and a plant engineer.

In addition to direct employment, the Project is expected to contribute to the community by:

- bringing gas closer to the communities of Alton, Brookfield, Stewiacke, and Truro through the development of a gas pipeline to the Alton facility;
- decreasing gas price volatility for Nova Scotia gas customers;
- decreasing gas price volatility and hence power price volatility for natural gas fired power generation;

- to the extent that stable gas prices result in greater gas fired power generation and hence less coal fired generation, a potential reduction in green house gas emissions;
- increasing regional security of supply levels;
- contributing to the tax base (income, property, and sales);
- allowing for the potential of developing other energy-related projects as a result of storage; and
- contributing to the overall economic growth of the community.

Overall, the project will be developed to minimize or eliminate adverse effects on the environment and maximize economic benefits to Colchester County and the Province of Nova Scotia.

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List of Acronyms Used in this Document

ADCP	Acoustic Doppler Current Profiler
ASME	American Society of Mechanical Engineers
ATV	All-Terrain Vehicle
BBL	Barrels
Bcf	Billion cubic feet
CCME	Canadian Council of Ministers of the Environment
CEAA	*Canadian Environmental Assessment Act*
CMM	Confederacy of Mainland Mi'kmaq
CoRDA	Colchester Regional Development Agency
COSEWIC	Committee on the Status of Endangered Wildlife
CSA	Canadian Standards Association
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EHS	Environmental, Health and Safety
EMP	Environmental Management Plan
EPP	Environmental Protection Plan
ESD	Emergency Shutdown
ESV	Emergency Shutdown Valve
GDP	Gross Domestic Product
Hazops	Hazardous Operations
HDD	Horizontally Directionally Drilled
M&NP	Maritimes and Northeast Pipeline
MEKS	Mi'kmaq Ecological Knowledge Study
MIT	Mechanical Integrity Test
NSDNR	Nova Scotia Department of Natural Resources
NSEL	Nova Scotia Environment and Labour
PPE	Personal Protective Equipment
ppt	Parts per thousand
RoW	Right of Way
SANS	Snowmobiles Association of Nova Scotia
SARA	*Species at Risk Act*
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UNSI	Union of Nova Scotia Indians
VEC	Valued Environmental Component
VSC	Valued Socio-economic Component
WHMIS	Workplace Hazardous Materials Information System
WMP	Waste Management Plan

1.0 INTRODUCTION

1.1 Project Overview

Alton Natural Gas Storage Limited Partnership (Alton, the Proponent) proposes developing an underground hydrocarbon storage facility in a series of engineered salt caverns near Alton, Nova Scotia (the Project). The general Project location is shown on Figure 1.1. The proposed Project is initially intended to help manage the supply of natural gas in eastern Canada and the United States. The Project will consist of multiple caverns developed by solution mining in underground salt deposits. These salt deposits are natural geological formations located at depths of over 700 m. The caverns and their accompanying facilities will be capable of storing billions of cubic feet of natural gas produced during peak production/low demand periods and delivering it back to the gas pipeline system during periods of supply deficits.

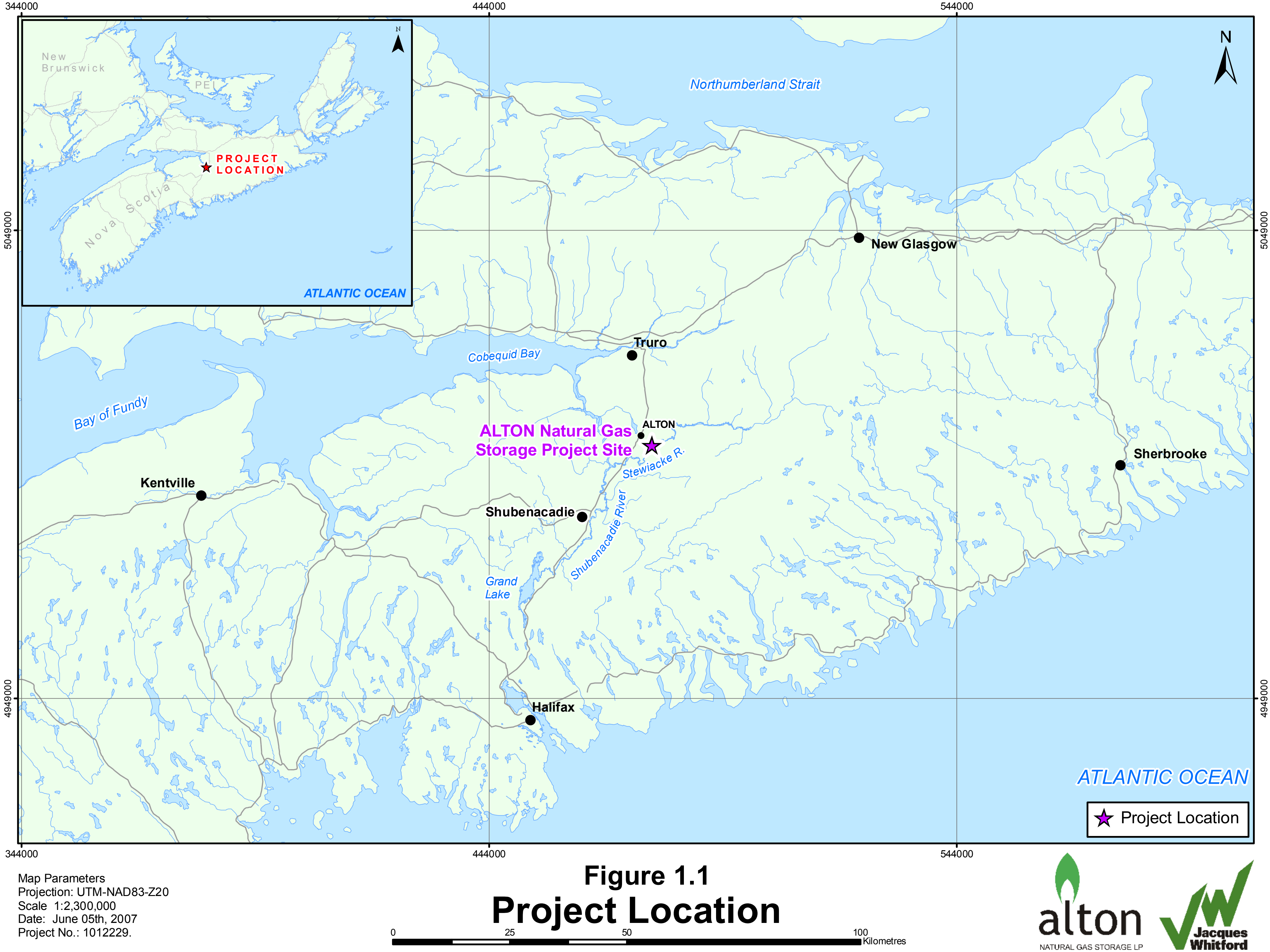
Figure 1.2 shows the proposed Project features which will include:

- buried pipelines from the area overlaying the salt formation to the Shubenacadie River, at a distance of approximately 12 km, where water will be drawn to the facility near Alton with diluted brine returned to the Shubenacadie River during the cavern development process; and
- an underground natural gas storage facility in engineered salt caverns near Alton, Nova Scotia.

Initially, four caverns of approximately 226,000 m^3 (60 m diameter by 80 m in height) will be formed over 18 to 24 months, with construction commencing in the fall of 2007. Depending on future market demand, the Project may develop as many as 10 to 15 caverns at a later date. If so, brining and gas storage operations may operate concurrently as additional caverns are developed.

Once this process is complete, natural gas will be injected and withdrawn from the storage caverns to meet market demands. There will also be a lateral gas pipeline linking the Alton facility with the Maritimes and Northeast Pipeline's (M&NP) natural gas transmission system Halifax Lateral; but this gas lateral is not currently included as part of the Project for environmental assessment and approval. It is not yet clear if Alton will be building the lateral or if the lateral will be built, owned and operated by M&NP. Discussions concerning the ownership and operation of the gas lateral are currently underway between Alton and M&NP. If Alton and M&NP reach agreement that Alton is to construct the pipeline lateral, then Alton will supply a separate Environmental Assessment at a later date.

The caverns will be developed in accordance with the requirements of the latest edition of Canadian Standards Association (CSA) Standard Z341 *Storage of Hydrocarbons in Underground Formations*, which is the world recognized underground storage standard dedicated to ensuring the safe development and operation of underground storage facilities.



Map Parameters
Projection: UTM-NAD83-Z20
Scale 1:2,300,000
Date: June 05th, 2007
Project No.: 1012229.

Figure 1.1
Project Location

alton NATURAL GAS STORAGE LP

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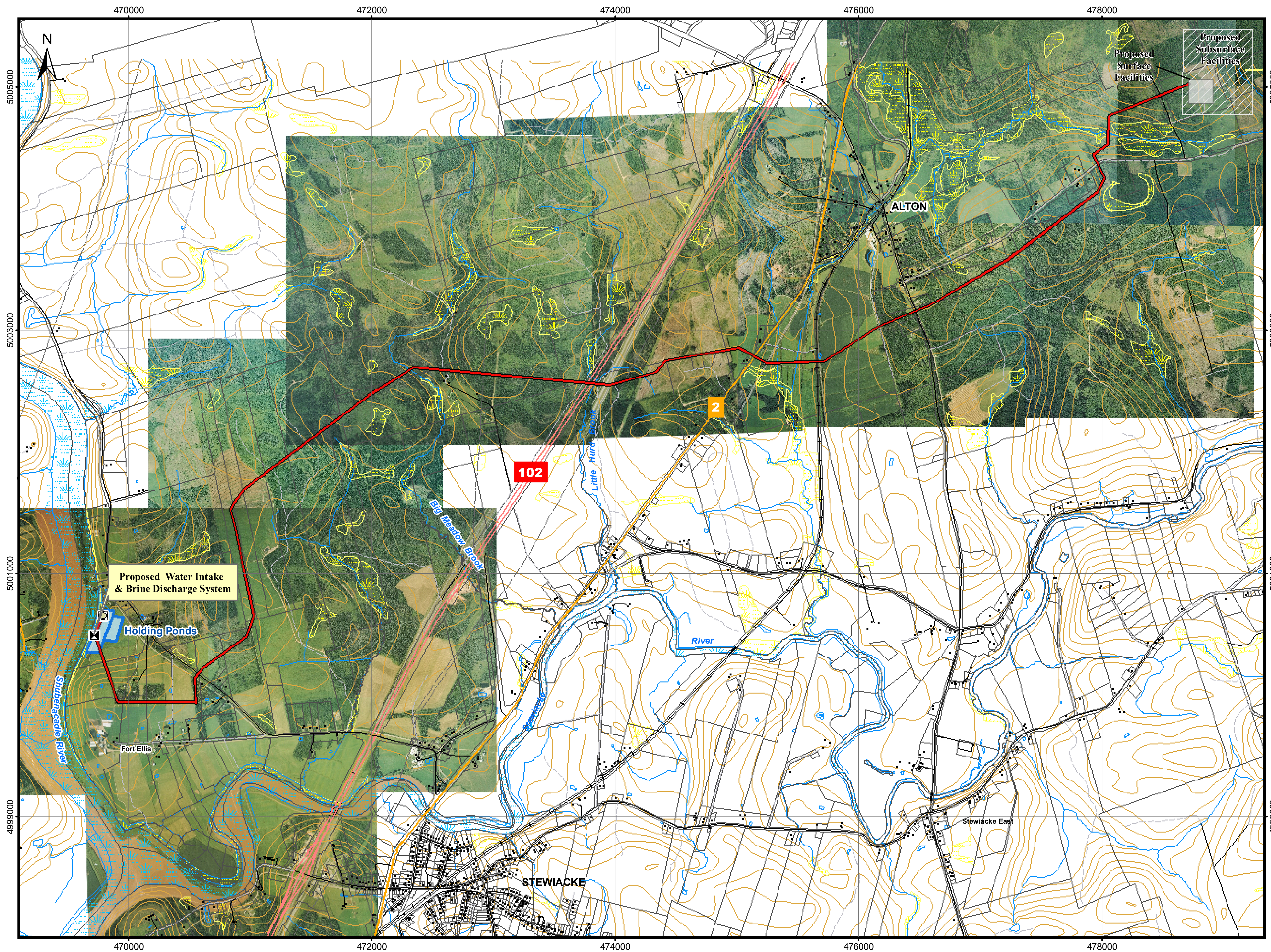

alton
NATURAL GAS STORAGE LP

Alton Gas Storage Project

Figure 1.2
Key Project Features

Map Features

- Water Intake
- Brine Discharge
- Building (1997, NSTS, 10k)
- Proposed Pipeline Route (20m ROW)
- Proposed Surface Facilities
- Proposed Subsurface Facilities
- Holding Ponds
- Bridge
- Major Highway
- Collector Highway
- Paved Road
- Unpaved Road
- Rail
- Utility Line
- Contour (5m)
- Watercourse
- Property Boundary

NSDNR Delineated Wetland

- NSDNR Freshwater Wetland
- NSDNR Saltwater Wetland
- Waterbody

Air Photos: Nova Scotia Aerial Photography, 2004

0 250 500 1,000
Metres

Map Parameters
Projection: UTM, NAD83, Zone 20
Scale 1 : 30,000
Date: June 06th, 2007
Project No.: 1012229.

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1.2 Proponent Information

Alton Natural Gas Storage LP is an equal limited partnership between Fort Chicago Energy Partners L.P. and Landis Energy Corporation. Fort Chicago and Landis Energy are publicly traded companies, listed on the TSX Exchange and TSX Venture Exchange, respectively, under the trading symbols FCE.UN and LIS. Landis Energy is the operator of the Project.

Contact Information for the Proponent:	Alton Natural Gas Storage LP PO Box 36052 Halifax, NS B3J 3S9 Tel: (902) 422-9718 Fax: (902) 422-9421 www.altongas.com Landis Energy Corporation Suite 2320, 444-5th Avenue SW Calgary, AB T2P 2T8 Tel: (403) 263-2118 Fax: (403) 264-8365 www.landis.ca
Project Contact:	Mr. Scott G. McDonald P.Eng., MBA Alton Project Manager Alton Natural Gas Storage L.P. Tel (902) 576-2675 Fax (902) 576-5332 smcdonald@altongas.com OR Mr. John Hilland, P. Geol. Vice President Alton Natural Gas Storage L.P. Tel: (403) 263-2118 Cell: (403) 804-4496 jhilland@landis.ca
Environmental Assessment Contact:	Ms. Virginia Soehl, M.R.M. Project Manager Jacques Whitford Ltd. Tel: (902) 468-7777 Fax: (902) 468-9009

Signature of Alton Project Manager

Date June 7/07

Signature of Environmental Assessment Contact

Date June 11/07

1.3 Purpose and Need for the Project

Landis Energy Corporation and Fort Chicago Energy Partners L.P., through Alton Natural Gas Storage L.P., are proposing to develop an underground storage facility for natural gas and other hydrocarbons near Alton, Nova Scotia, to meet the growing demand for natural gas storage in Nova Scotia, New Brunswick, and Northeastern United States. Presently, no storage facilities connect to the Maritimes & Northeast Pipeline system.

1.4 Regulatory Framework

Environmental assessment (EA) in Nova Scotia is regulated under the province's *Environment Act* and Environmental Assessment Regulations. The Alton Project triggers the provincial environmental assessment process as a Class I Undertaking because it meets the following criteria:

- A facility engaged in the production, wholesale storage or wholesale distribution of dangerous goods.
- A storage facility with a total capacity of over 5000 m^3 intended to hold liquid or gaseous substances including, but not limited to, hydrocarbons or chemicals, but excluding water.

This report, prepared on behalf of Alton by Jacques Whitford Limited, is a draft Environmental Registration for the Alton Project made pursuant to the Environmental Assessment Regulations.

Requirements for assessment under the *Canadian Environmental Assessment Act* (*CEAA)* are not anticipated at this time.

One or more provincial approvals (permits) will be required including a Hydrocarbon Storage-Area Licence. In December 2006, Alton submitted an application for an Underground Hydrocarbon Storage-Area Licence to the Nova Scotia Minister of Natural Resources. This Underground Hydrocarbon Storage-Area Licence provides the holder an exclusive right to conduct activities required by the regulations or the licence to evaluate the potential for underground storage use of the lands covered by the licence. Upon approval by the Minister, this licence must be renewed annually. Once a Hydrocarbon Storage-Area Licence is granted, an application for a Hydrocarbon Storage-Area Lease is submitted to the Minister of Natural Resources. This Hydrocarbon Storage-Area Lease provides the exclusive right to develop and utilize the storage area for the injection, storage and withdrawal of hydrocarbons in the area covered by the Hydrocarbon Storage-Area Licence. An Industrial Approval under the Nova Scotia *Environment Act* will be required to construct and operate the facility. Other approvals such as a Water Approval (*e.g.*, for water withdrawal) may also be required. It is anticipated that Project discharges, such as diluted brine, will be regulated under provincial approval.

1.5 Organization of the Report

Following this introduction, this EA includes the following sections:

- A description of the proposed Project (Section 2.0);
- The scope of the assessment and the methodology used to assess the environmental effects (Section 3.0);
- A description of the methods of public involvement and steps taken to address public concerns (Section 4.0);
- A description of the existing environmental and socio-economic setting of the Project (Section 5.0);
- The environmental and socio-economic components effects assessment, including proposed and required mitigation and monitoring and follow-up studies (Section 6.0);
- A description of potential malfunctions and accidental events (Section 7.0);
- A summary of the report and concluding statements (Section 8.0);
- A list of references cited including literature and personal communications (Section 9.0); and
- Several appendices of technical information.

2.0 PROJECT DESCRIPTION

2.1 Project Infrastructure and Activities

2.1.1 Construction

The Project will require the construction of the following main components: the water intake and diluted brine discharge facilities; laying and connecting the water and brine pipelines; drilling vertical holes to initiate the creation of the salt caverns; and developing the salt caverns.

2.1.1.1 Site Preparation

Water intake and brine discharge facilities will be established at the Shubenacadie River Estuary. Work will consist of the installation of sheet pile walls near the low tide level of the Estuary to act as a coffer dam to allow for construction of intake and discharge ports, as well as excavation for open spillways between the Estuary and a mixing and brine dilution pond. Excavation and accompanying berm construction will take place behind an existing dyke to facilitate the mixing pond construction. It is anticipated that only minimal construction will be required within the intertidal zone; the extent will be determined during final design of the intake and discharge structures.

Surface drilling pads will be built at the underground storage facility to accommodate the drill rig and associated equipment. Pad construction will consist of groundclearing and leveling and a gravel cover to ensure a level and stable work site. It is anticipated that two pads approximately 80 x 80 m and two smaller pads will be built. Access will be via secondary rural roads to local logging roads, with short extensions of the logging roads built to access the cavern drilling sites. Daily traffic may be on the order of 50 gravel trucks per day for three weeks. A backhoe and bulldozer will be on site.

Local supplies will be used where feasible during construction, including potable and raw water, crushed rock and sand, and wood products.

2.1.1.2 Water Intake and Brine Discharge Facilities

Electric-driven pumps will be installed at the river water intake to pull water from the river and move it through the equipment and pipelines. A centrifugal separator system will be installed at the water intake to clean the bulk of the river sediment load from the water and a de-aerator unit will be installed to prevent corrosion in the pipeline and downstream brining equipment.

Brine monitoring equipment will be installed on the brine system for leak detection and system control. A small brine pond will be constructed at the river to hold the brine for physical monitoring and to allow for continuous flow through the pipelines with intermittent flow to the mixing pond. The mixing pond will be constructed to mix the brine with estuary water and control its outlet to acceptable salinity levels.

Electrical and control equipment will be installed at this location to operate and ensure safety of this equipment.

Materials used for pipe, fittings, valves, pumps, electrical and safety equipment, instrumentation, and other components will have properties that meet design conditions during construction and operation. The design and installation will comply with the applicable requirements of ASME B31.3. This

American Society of Mechanical Engineers Code contains requirements for piping typically found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants, and related processing plants and terminals. The requirements cover materials and components, design, fabrication, assembly, erection, examination, inspection, and testing of piping. Also included is piping which interconnects pieces or stages within a packaged equipment assembly.

2.1.1.3 Water line Installation

Approximately 12 km of buried water line will be installed between the area overlaying the salt formations to the Shubenacadie Estuary for water withdrawal and diluted brine discharge. The pipeline right-of-way (RoW) will be cleared to a width of 15 m to 20 m. Two steel or plastic pipelines of 324 mm diameter will be buried in a common trench to a depth of 1.8 m in existing material. Trench blocks will be added where required on slopes to prevent the RoW from becoming a groundwater conduit. A de-aerator unit installed at the water intake will prevent corrosion in the pipeline and brining equipment. Flowing streams, highways and the railroad will be horizontally directionally drilled (HDD), and wetlands, including a 30 m buffer (where feasible), will be avoided during the water line installation. A separate and future application will be made for a gas pipeline to connect the storage facility to the M&NP Halifax Lateral.

The pipeline installation will require equipment to clear and pile or remove timber in forested areas, dig the trench (HDD under roads, railways, and creek crossings), lay the pipeline, backfill the trench and test completed works. The pipe sections will be joined prior to laying in the trench. Trenches will be backfilled with material dug from the trench. Daily volume is expected to be 10 to 15 trucks, with heavy equipment following the pipeline route.

All pipeline materials and components will have properties that meet design conditions during cavern development and operation.

All water pipelines will comply with the applicable requirements of CSA Standard Z662 and will be capable of withstanding:

- the maximum system pressure;
- the maximum and minimum temperatures that could be experienced by the system; and
- the possible effects of hydraulic hammer.

These pipelines will be buried to a depth of approximately 1.8 m to avoid freezing in winter.

2.1.1.4 Cavern Location Selection

Exploration work to date and geotechnical analysis confirms a geologically sound salt formation exists between 500 m and 1000 m below grade in the Alton area. In addition to its proximity to the M&NP Halifax Lateral, the proposed site has a number of advantages. These include its geological properties and other valuable infrastructure such as roads, power lines, rail lines, and a tidal estuary as the water source.

Extensive geotechnical testing of the salt deposit and cap rock will determine a safe and stable cavern diameter, height, spacing and maximum/minimum operating pressures. CSA Standard Z341 provides minimum standards for all of these parameters. It is expected that the salt caverns will be approximately 60 m diameter by 80 m in height with a volume of approximately 226,000 m^3 each.

As per CSA Standard Z341, adjacent caverns will not be placed closer than twice the average diameter of the caverns, measured from centre of one to centre of another. Cavern pressures will not exceed safe fracture pressure limits determined by geotechnical analysis and the requirements of CSA Standard Z341. Sonar surveys will be done at regular intervals during the development of the caverns to ensure that the dimensions and shape of the caverns are developing as planned, and adjustments to the cavern development will be made to correct any abnormalities before they become a concern.

The cavern development wells will be drilled from a surface pad site on property owned by Alton. Figure 2.1 shows a wellhead comparable to what will be used in the proposed Project.

FIGURE 2.1 Example Wellhead

Source: PB Energy Storage Services, Inc.

Prior to preparation of detailed designs for developing and commissioning the storage facility, one core hole that penetrated the storage zone has been drilled and cored through the caprock and the salt formation. This core hole was developed to provide detailed data on the geological properties of the caprock, the salt deposit and the related geological structure. The cavern development wells will require larger diameter bores, to accommodate surface casing, a possible intermediate casing, and a final cemented casing of approximately 340 mm diameter.

2.1.1.5 Cavern Development

Salt is an ideal substance in which to develop storage. It dissolves easily in water, making cavern formation through dissolution possible. Salt is often found in large, relatively homogeneous deposits. Unlike rock, which can fracture in a brittle manner, salt deforms in a plastic manner throughout geological time periods, and as such is devoid of fractures. As a result, salt forms a tight seal through which stored fluids or gas cannot escape. Salt caverns for natural gas storage have been used extensively for many decades throughout North America.

The cavern development process is summarized in Table 2.1 and described in greater detail in the following sections.

TABLE 2.1 Components of the Solution Mining Process

Component	Features
Brining Water Intake	Water will be drawn directly from the Shubenacadie Estuary, to provide water for brining caverns. The pipe intake will be set in a sheet pile wall structure which will extend slightly (to be determined with final design) from the river bank edge to allow the intake to be set below the low tide mark, and to allow current-induced scour along the intake to prevent sand intrusion. The intake will provide up to 11,750 m^3 per day, using centrifugal pumps set in a sump near the river bank. The intake pumps will be driven by electrical motors and will therefore produce no air emissions locally and minimal noise. This intake water will flow through centrifugal separators to remove sediment, with the sediment discharged back into the river which is normally turbid. This will provide 10,000 m^3 per day of clean water for injection into caverns. An ice and debris trash rack and a fish screen will be located at the intake. Screening will comply with DFO guidelines.
Brine Mixing Pond Water Intake	Estuary water intakes for the brine mixing pond will be set in similar sheet pile wall structures as the brining water intake. These will provide water for brine pre-dilution prior to discharge into the Estuary. They will be controlled by automatic gates which will open and close once during each tidal cycle. Ice and debris trash rack and fish screens will be located at the intakes.
Brine Mixing Pond and Discharge	A brine mixing pond located adjacent to the river bank will allow brine to be diluted by river water prior to being discharged into the Estuary. The exact dimensions of the pond will be finalized following substrate analysis. It is expected that the depth will be 3 to 4 m and the pond will be able to hold 60,000 to 100,000 m^3. Water will flow into the pond during periods of low salinity and will be mixed with brine at an approximate ratio of 10:1 water:brine. The “down river” mixing pond-to-Estuary connection will consist of a rectangular spillway without gates that will be open to the Estuary continually. An ice and debris trash rack and fish screen will be located at the spillway connection.
Brine Holding Pond	A brine holding pond will provide surge capacity for times when the brine mixing pond is not accepting brine input.. This pond will be smaller and shallower than the mixing pond. Exact dimensions will be finalized following substrate analysis. This will allow continuous brining of caverns.
Water Supply and Brine Disposal Pipeline	Approximately 12 km of 324 mm diameter steel or plastic water supply pipeline will be installed between the water intake and the underground storage facility. A steel brine disposal pipeline, also 324 mm diameter, will be installed in the same trench as the water supply pipeline. These pipelines will be buried to a depth of approximately 1.8 m to avoid freezing in winter.
De-aerator Unit	Once the intake brining water passes through the centrifugal separator, it will flow through a de-aerator unit to decrease the oxygen content in the brining water. This will greatly reduce the corrosion that will occur in any steel water and brine pipelines, facility piping, equipment and the well tubing and casing. The de-aerator unit will also prolong the life of the interconnecting piping and brining equipment and greatly decrease the likelihood of any future failures of the well casing strings. A vacuum-type de-aerator is proposed to remove most of the oxygen by mechanical means. Chemical de-gassing processes are also available; however, these will not be considered as they may lead to environmental concerns when returning the dilutedbrine to the Estuary.
Settlement Tank	A 159 m^3 (1,000 BBL) atmospheric settlement (surge) tank will be installed at the cavern injection pumps. This tank will allow some of the remaining particulate matter in the brining water to settle out before the water is injected into the cavern. It will also serve as a source of positive hydraulic head for the injection package booster pump, and a surge volume in the system. The tank will be equipped with a secondary lined containment dyke to capture any leaked water. This dyke will also act as a barrier to physical damage by a vehicle. Regular inspection and maintenance of this system will ensure its integrity. This tank may be a conventional welded steel storage tank; however, a bolted tank is recommended for ease of shipment. This tank will be installed inside of a lined secondary containment dyke for spill contingency.
Injection Pumps	The injection pumps will consist of booster pump/injection pump packages. The water will flow from the settlement tank to the centrifugal booster pump, which will ensure that the injection pump has sufficient suction head after passing through piping and filters. The injection pumps will be positive displacement pumps, which will overcome the friction and head loss through the well tubing, cavern, nitrogen separators and discharge pipeline to return the diluted brine to the Estuary. Based on preliminary calculations, there will likely be three or four of these injection pumps on site comprising a total pumping power of 600 kW (800 Hp). These pumps will be driven by electric motors and will therefore produce no air emissions locally and minimal noise.

TABLE 2.1 Components of the Solution Mining Process

Component	Features
Injection Piping Manifold Skid	Injection piping, valves, controls, pumps and metering will be installed on skids for ease of construction, future relocation, and installation. Metering on a skid will track the amount and salinity of water injected and brine removed from each cavern, thus allowing for tracking of cavern growth. The skids will include the conventional/reverse flow switching valves, injection meters, control valves as well as the inlet and return brine headers, and water supply and return brine sample points.
Nitrogen Generation Plant	A control fluid is required in the formation of a salt cavern to control the development ensuring that the ultimate shape of the cavern is structurally sound. The use of nitrogen for this purpose is recommended as it is inert and would not constitute an environmental concern if any were to leak. The nitrogen is compressed into the cavern where it stays at the surface of the brine to prevent the brine within the cavern from contacting the cavern roof. A nitrogen generator or nitrogen supply vessel will be required to produce nitrogen blanket gas. A unit will be required that can produce 150 scfm (4.25 m^3/min) of nitrogen and compress it down into the cavern to a pressure of over 11,032 kPa (1600 psig). This rate will allow the cavern well bore and the top 25 mm (1") of the cavern to be filled with nitrogen in four days. This nitrogen is taken from the air (which is composed of 78% nitrogen) and can therefore be safely returned to the atmosphere after use. The nitrogen compressor will be driven by an electric motor with no air emissions locally and minimal noise.
Brine Separators	A brine separator will be installed on the brine return lines for each of the caverns. These separators will allow the total amount of returning brine and nitrogen to be metered, which is critical for the proper monitoring and control of the cavern development as mentioned above.

Preliminary Drilling Activities

In order to ensure a safe, competent, and environmentally sound well bore, the wells will be completed as specified in CSA Standard Z341. The cemented casings installed in each storage well will include, where necessary:

- One casing set across all potable water-bearing zones to prevent the incursion of any development or stored fluids into these zones and to prevent the incursion of this water into the storage facility. This is in addition to the required surface casing used to isolate any shallow potable water formations.
- Two casings set across all corrosive zones to prevent these corrosive zones from affecting the integrity of the pressure containing strings.
- One casing set across all hydrocarbon-bearing or porous zones located above the storage zones to prevent infiltration of these zones into the salt cavern operations.
- As per CSA Standard Z341, casing and surface casing set deeper than 450 m will be designed for collapse resistance based on a gradient 12 kPa/m of depth with no internally applied pressure.
- Cement bond logs will be obtained for each cemented casing to ensure that all zones encountered are fully sealed by the casing in question. The blended cement slurry will be allowed to cure for a time necessary based on the bottom-hole temperature for the cement to attain a compressive strength of 3500 kPa prior to conducting a cement bond log.

- Wire line logs will be obtained for all storage wells to provide, for formations penetrated by the well: the natural radioactivity of the formation to assist in determining formation tops; the lithology of the formation; the size of the hole for cement volume calculations; the depth of penetration into the salt section for production casing setting requirements; and the location and identification of any significant geological anomalies throughout the entire salt section and 100 m above the salt section.
- A casing inspection log will be obtained on the final cemented casing to ensure its integrity.
- Additional testing is also mandated for the casing string in accordance with CSA Standard Z341.

The drilling rig would be brought in over a five-day period on approximately 30 to 40 flatbed trucks, including casing and supplies. Daily (or several times weekly) traffic would include water trucks, a vacuum truck, fuel truck, miscellaneous supplies, and personnel vehicles amounting to about 3-10 vehicles per day over a two-month period.

Water Intake

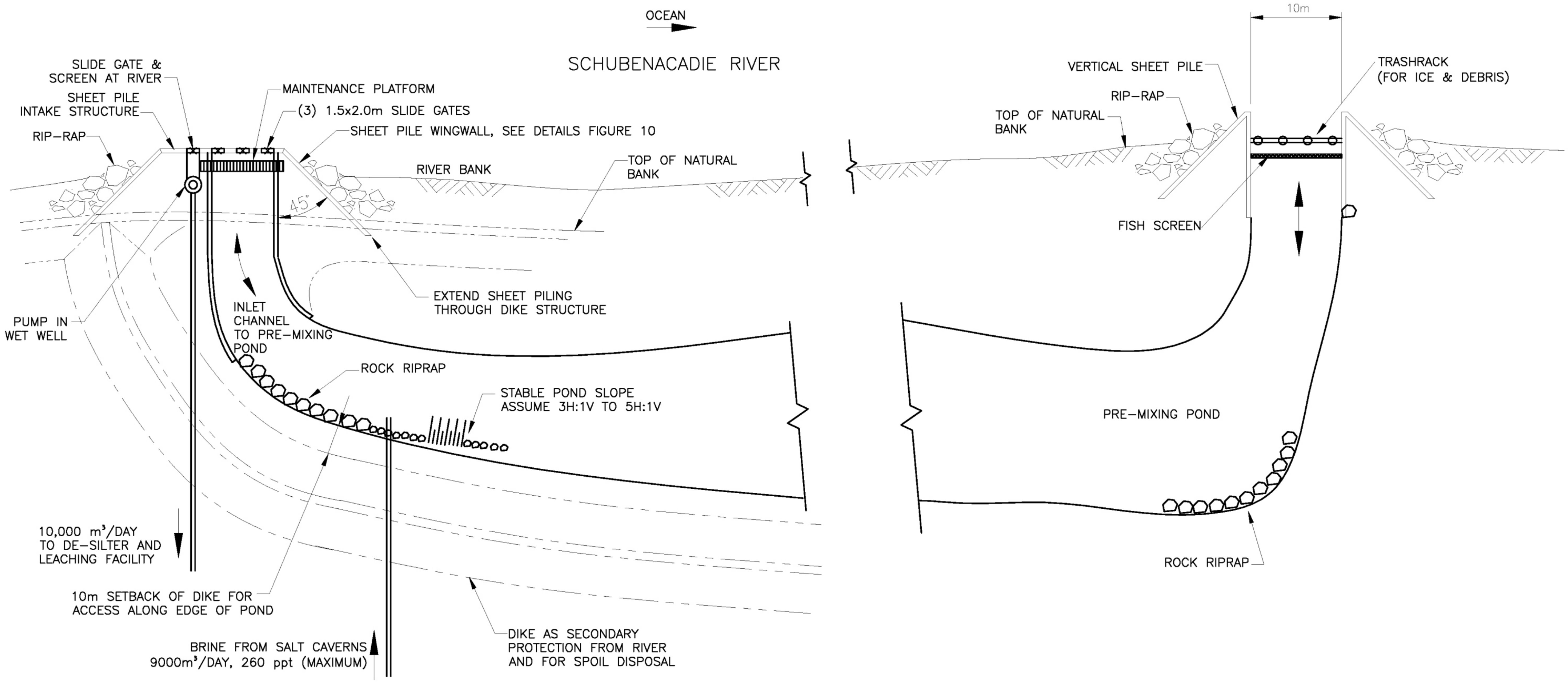
Initially it was proposed that the Project would use either shallow sandpoint type of wells or deep bedrock wells adjacent to the Shubenacadie Estuary as a source of brining water, as the groundwater in that area is brackish and therefore not potable. Pumping tests were conducted in test wells drilled into the sand and also into the bedrock, but flow rates were far below what would be required for the Project. Also, concern was raised regarding the possibility of drawing in fresh groundwater which could be present in the area. Therefore, the sandpoint and deep bedrock water intake alternatives were rejected.

The proposed water intake design is described in Table 2.1 and shown in Figure 2.2. Water will be drawn directly from the Shubenacadie Estuary. The Project will use relatively small amounts of water, compared to overall flow at the intake site, to minimize any potential impact on the aquatic environment. On a large tide, the ebb flow in the Shubenacadie River near the proposed Project location is over 8 million cubic metres per day and the flood flow is approximately 6 million cubic metres per day. Small tidal range flows are approximately 50% of large tidal flows. During the brining process, the Project proposes drawing off 11,750 m^3 per day or 0.15% of ebb flow in the vicinity of the Project per day. For the purposes of dilution, approximately 100,000 m^3 per day will be drawn to the mixing pond and returned to the Estuary (1.25% of ebb flow). Intake water velocities will comply with appropriate regulations.

Solution Mining

Initially, four cavern development wells will be drilled using a standard oil and gas drilling rig (Figure 2.3). Due to a restricted hole / initial cavern size, water flow rates used for brining will initially be less than the design capacity and discharge brine salinities will not be saturated. As the caverns increase in size, the water flow rates will increase, but will never be greater than 10,000 m^3/day, and water retention time in the caverns will increase, allowing the brine to eventually become saturated with salt. Within 60 weeks of start up, the brine will approach saturation. Brining operations will continue until one or more caverns are of sufficient size to convert to gas storage. Subsequently, brining operations will occur simultaneously with gas storage operations, with further drilling of cavern development wells as caverns are converted to gas storage.

Caverns can be formed by direct circulation or by reverse circulation. The cavern shape must be carefully controlled to avoid impacting the structural integrity of the storage system. Various techniques are available to accomplish this and will be incorporated into the detailed design. The caverns will be developed in accordance with the requirements of the latest edition of Canadian Standards Association (CSA) Standard Z341 *Storage of Hydrocarbons in Underground Formations*, which is the world recognized underground storage standard dedicated to ensuring the safe development and operation of underground storage facilities.



DRAFT

CONCEPTUAL DESIGN ONLY

Figure 2.2
Preliminary Design of Brine Intake and Discharge System

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	BY	DATE
DESIGNED	WV,	2007–02–19
DRAWN	MOD,	2007–02–23
CHECKED		

APPROVALS: PROCESS / MECH. / STRUCT. / ELECT./INSTR. / OWNER

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

REFERENCE DRAWINGS | DRAWING NO. | NOTES: –

NO.	REVISION	BY	DATE	CHKD.	APPR.
A	ISSUED FOR INFORMATION	MOD	07–02–27	–	–

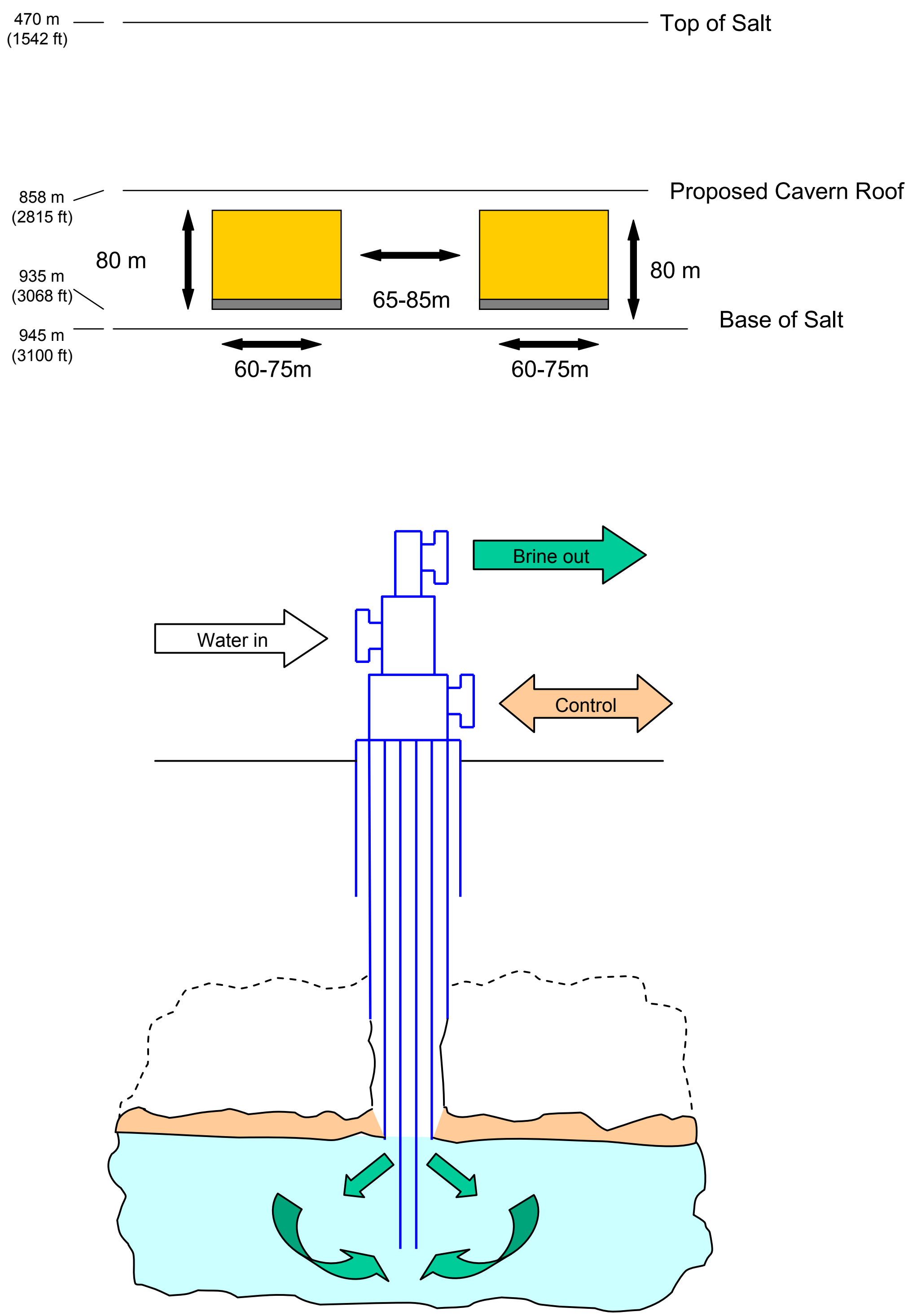
SEAL: | PERMIT:

CLIENT: ALTON NATURAL GAS STORAGE LP

TITLE: SCHUBENACADIE RIVER FACILITIES INTAKE/OUTLET STRUCTURE AND PRE–MIXING POND – OPTION 3

SCALE	PROJECT NO.	DRAWING NO.	REV.
NTS	102–01–04		A

FIGURE 2.3 Diagram of Proposed Well Configuration and Simplified Process Flow Diagram for Cavern Development



Source: John Wolnick & Associates Inc.

Discharge of Brine

Hydrological studies of the Shubenacadie Estuary were performed by Martec Inc. of Halifax from August to December 2006. Water flow data was obtained by using an Acoustic Doppler Current Profiler (ADCP). Salinity was measured with individual samples and with continuous recording type of submersed instruments. Results are presented in Appendix A and show an extremely dynamic aquatic environment, as well as large total water flow volumes, of several million cubic metres of water per tidal cycle. A description of the physical properties of the Shubenacadie Estuary is also included in Section 5.3.

The proposed brine discharge design is described in Table 2.1 and shown in Figure 2.2. The Project proposes to build two brine ponds, a brine holding pond that will hold saturated brine and a brine mixing or dilution pond. (Please see below for a more complete description of the brine ponds.) The ponds will be built by excavating material and piling it to form dykes. The exact dimensions of the mixing pond will be finalized following substrate analysis. It is expected that the depth will be 3 to 4 m and the pond will be able to hold 60,000 to 100,000 m^3. The brine holding pond will be considerably smaller and shallower and exact dimensions will be determined upon final Project design. Little material is expected to be imported, aside from some gravel and rock at certain points in the pond where strong currents are expected. Using best design and engineering practices, the ponds will be designed to prevent failure under a variety of environmental conditions, including high precipitation.

Daily volume of traffic is expected to range from 10 to 30 vehicles. Traffic associated with the development of the intake and discharge systems is expected to consist of earth movers, a large backhoe, smaller backhoe, a sheet pile driver, bulldozer, flatbed transport trucks, cement trucks, welding truck(s), and pickup trucks. Daily traffic is expected to consist of transport trucks, some dump trucks, and personnel vehicles.

The brine will be transported by pipeline from the cavern development site to the Shubenacadie Estuary intake/discharge site where it will be held in a brine holding pond then discharged into a mixing pond adjacent to the Estuary. Water from the Estuary will flow into the mixing pond during a rising tide where it will mix with the brine to dilute the salt content to 25 ppt or less. The diluted brine will then flow into the Estuary during ebb tide, when the salinity of the Estuary is at or near the maximum of the tidal cycle. There will be a period during each tidal cycle when there will be no brine discharge into the mixing pond, in order to flush out the pond, to mimic as close as possible the natural salinity fluctuation in the Estuary, and to ensure complete flushing of the discharged water out of the Shubenacadie Estuary system. An intake and discharge design report prepared by Matrix Solutions Inc. of Calgary is included in Appendix B.

Although the discharged water may be slightly higher in salt content than the Estuary on any given day, especially during periods of high rainfall, the salt concentration at the point of discharge will be within the naturally occurring upper concentrations of the Estuary. The resulting zone of influence has been modeled assuming the maximum salinity level of 25 ppt for the discharge and 10 ppt for the Shubenacadie River. The decay of brine solution in the near field is most rapid within 30 m of the outfall. Beyond this point, the decay is more gradual. Predicted salinity (above ambient) at a downstream distance of 1000 m from the outfall is 1.77 ppt. Modeling results also indicate that the brine becomes vertically mixed within 250 m of the point of discharge. For all tidal conditions modeled (see Appendix C), the brine becomes attached to the east bank a short distance downstream of the outfall. Due to the momentum of the brine discharge, the zone of influence initially extends into the Estuary a distance of approximately 20 m and then decreases to a width of 10 m approximately 150 m downstream where the Estuary measures 240 m wide. From this location, the zone of influence gradually begins to increase in width (from the east bank) to approximately 20 m at a distance of 1000 m downstream where the Estuary is approximately 300 m wide. The Project design is such that concentrations of salinity of the brine discharge will mimic natural variation of salinity in the system and will not exceed 25 ppt. Further details of modeling results are included in Appendix C.

The mixing of the brine discharged from the proposed mixing pond is controlled by the river dynamics at the outfall location out to the river mouth near Maitland. Most of the intense mixing occurs near the discharge location and the diluted brine is transported to Cobequid Bay by the river during the falling tide. The focus of impacts would be in the immediate discharge areas and throughout the river itself since higher concentrations and any perceptible changes would be more evident in these areas. Beyond the river mouth, the volume of water available for mixing increases by orders of magnitude.

Ratios of the volume of discharged brine to the volume of receiving waters is not especially helpful in pinpointing areas of concern but are useful in giving a global perspective to the quantities involved. For example, the volume of water exchanged over a 12-hour tidal cycle at Cobequid Bay is 2,446,000,000 m^3 (Gregory *et al.* 1993). The resultant increase in salinity if the brine were theoretically completely mixed, would be insignificant (4 $x10^{-4}$ ppt). Thus, this region of interest is clearly within the river itself and the pre-mixing pond attempts to reduce the salinity levels at discharge. The discharge is to occur during high flow rates to maximize rapid mixing with the large volumes of river ebb flows.

Surface Facilities

The intake and discharge surface facilities proposed near the Shubenacadie River include: a water intake system; one or more buildings with equipment for pumping and treating the water, including the meters and valves to measure and control the water flow, a centrifugal separator and a de-aerator; brine discharge facilities; interconnecting piping; and a utility building. The leach water transfer pumps will provide sufficient water pressure to move the water through the water pipeline to the cavern development site. The water treatment system is entirely mechanical. It consists of a centrifugal separator used to remove most suspended matter from the intake water and a vacuum de-aerator to remove oxygen from the water to prevent corrosion in the system. The utility building will house electrical motor controls and utility equipment used in the automated operation of the intake and discharge systems. The brine discharge system equipment includes pipeline downstream-metering for line break control, a brine storage pond, a brine mixing pond, river discharge works, and interconnecting piping and valves. The buildings will be self-framing style or constructed of a steel frame with painted steel clad siding, on pile foundations or a poured concrete foundation.

The proposed cavern development surface facilities and equipment at the cavern site will cover a footprint of approximately 200 x 200 m to make room for both the cavern development facilities and the future gas handling facilities. The cavern development facilities will consist of a leach water surge tank, a leach water injection building, four brine separators vessels, a nitrogen injection building, a utility building and a field office and control building. The leach water injection building will contain the leach water injection pumps as well as the control valves and metering necessary to control the flow into the cavern wells. The utility building will house electrical motor controls and utility equipment used in the automated operation of the cavern development facilities; space will be provided for the installation of utility equipment for the future gas handling facilities. The field office will be staffed during the daytime on work days, and will be equipped with systems to continuously and safely monitor and control the facility and to call out an on-call operator 24 hours per day; the same office will also be used for the Gas Handling Facilities. All outdoor lighting will be directed and shielded so as to illuminate only the areas that must have adequate lighting for safety of operations personnel. As most equipment will be housed in buildings, the amount of outdoor lighting will be minimal, and will generally be limited to lights mounted on the buildings for illumination of entrances and adjacent equipment. Some of this may be actuated by motion sensors, and can then be turned off except when needed. There will likely be some yard lighting that cannot be avoided; where this occurs, it will be shielded and directed so that little escapes to the sky. The cavern development facilities will remain on site to develop additional caverns once the first four are complete and for use in periodic testing of the completed caverns.

As the development of the first four caverns near completion, the gas handling facilities construction will begin. The gas handling equipment will consist of gas separation, metering and control systems located in a meter building, compressor building(s), gas dehydrator building(s), a vent stack and inter-connecting piping. A gas transfer pipeline will be built, likely by the gas transmission company, to connect the facilities to the existing transmission system. The compressors will require large aerial coolers that will be outside, adjacent to the compressor building. The dehydrators will have towers approximately 10 m high that will protrude through the roof of the dehydrator building or will be located adjacent to the building. The vent stack will be approximately 15 m tall and will consist of sections of steel pipe supported by guy-wires. The stack is for emergencies only, to carry gases released from the facility's pressure relief system to a higher altitude for dispersion and away from dangerous ignition sources. There will be no continuous venting or flaring of hydrocarbon vapours on site. Utility fuel gas systems will likely be located in the metering building; other facility controls and utilities will be located in space provided in the utility building or the office and control room constructed as part of the cavern development facilities. The buildings for the gas handling facilities similar to those for the cavern development facilities will be self-framing style or constructed of steel frame with painted steel clad siding, on pile foundations or a poured concrete foundation.

Preliminary designs for the facilities are included in Appendix D. Wellheads, as shown above, will be spaced out over a larger area on the order of several acres. Figure 2.4 shows an example facility comparable to the proposed Project

FIGURE 2.4 Example Surface Facility

Source: Bluewater Storage Facility

2.1.2 Gas Storage Operation

Operations for leaching a cavern are expected to take at least 18 to 24 months, with the expectation of developing further caverns, or expanding existing caverns, in the future. Upon completion of each cavern, the cavern will be converted for natural gas service. Depending on future market demand, the Project may eventually develop as many as 10 to 15 caverns.

When a cavern reaches a sufficient size to be converted to a gas storage cavern, the outer tubing string is removed and only the inner tubing string remains, suspended close to the bottom of the cavern. The brine will be displaced from the cavern by introducing natural gas into the cavern through the outer casing, which will be cemented in place to a depth equal to the top of the cavern. This introduced gas will force the brine into the remaining inner casing string and out of the cavern.

The caverns will be developed in accordance with the latest edition of CSA Standard Z341 *Storage of Hydrocarbons in Underground Formations*, to ensure safe development and operation. As a result of this standard, there has never been a significant incident at a natural gas storage facility in Canada. One of the oldest facilities in Canada, located in Saskatchewan, has been in operation for more than 40 years without incident.

Natural gas will be injected and withdrawn from the storage caverns to meet market demands. There will also be a lateral gas pipeline linking the Project with the M&NP natural gas transmission system, approximately seven kilometres east of the underground storage facility. However, this gas lateral pipeline is not currently included as part of the Project for environmental investigation.

2.1.2.1 Well and Cavern Integrity Testing

Prior to a developed cavern being placed in service to store natural gas, a mechanical integrity test (MIT) will be used to test the ability of the cavern to fully contain the stored product. This test will be conducted to ensure the pressure containment of the cavern system, including the wellhead, product casings, casing seat, and the cavern cavity. For the initial MIT, nitrogen is the preferred test medium because it is an inert gas, and therefore is environmentally benign.

The nitrogen/brine interface test is a method for testing the integrity of a cavern's wellhead, casing, tubing and cemented annulus between the production casing and the formation at the casing shoe area. With this procedure, the well is tested to the desired casing shoe pressure with brine in the cavern and well tubing, and with nitrogen in the outer annulus of the cased section of the well and extending below the casing shoe. During the test period, brine and nitrogen pressures are continuously recorded at the surface. The nitrogen/brine interface level is determined with a recording instrument, such as an electric line density log, at the beginning and end of the test period. The test and its interpretation are described more fully in CSA Standard Z341.

Based on past projects, it is expected that the outer tubing string will be raised at 20%, 40%, and 70% of total cavern development height. At 100% of cavern development, the inner and outer tubing will be removed and the inner tubing reinstalled to remove the brine and prepare the cavern for gas injection.

Sonar surveys will be conducted just prior to each of the workovers to determine if the cavern is developing as predicted. Depending on the actual development of the cavern, additional adjustments of the outer tubing string and additional sonar surveys may be required.

2.1.2.2 Monitoring

Surface equipment for natural gas monitoring includes wellhead separators, meter station, compression for gas injection and withdrawal, dehydrators, and emergency shutdown valves. Facilities are monitored remotely 24 hours per day, and full time staff will use the on-site field office.

2.1.2.3 Wellhead Separators

For each well, during gas storage operations, a separator package will be required to remove any residual water or brine that is drawn out of the well by the gas. As the gas in the caverns is depleted, the wellhead separator removes water vapour from the caverns that may condense on cooling.

2.1.2.4 Meter Station

As per CSA Standard Z341, there will be a meter station to measure gas flow to and from each well, as well as the total flow from and to the pipeline. The meter station will also contain gas flow control valves and pressure monitoring instruments for control and inventory calculations. This equipment is very important in maintaining a safe salt cavern storage facility. All gas entering the caverns, exiting the caverns and being consumed by compression, instrumentation, and facility heating will be carefully measured to ensure there are no leaks.

2.1.2.5 Gas Compressors

Gas compressors will be installed to withdraw gas from the caverns and inject gas into the caverns. Approximately two compressors totaling 1,875 kW (2,500 HP) will be required to move the 159,280 m^3/hr (135 mmscf/day) of gas as required for the proposed facility. The compressors will be natural gas engine-driven.

2.1.2.6 Dehydrators

Gases stored in the cavern will pick up any water vapour from brine remaining in the bottom of each cavern that cannot be removed. Sufficient dehydration equipment will be installed to remove this water from the gas prior to returning it to the Maritimes & Northeast Pipeline. Dehydrators are required to maintain the minimum water content specifications set by the gas transmission companies.

Dehydrators operate by passing the gas through tri-ethylene glycol, which absorbs moisture from the gas stream. The dehydration process is not connected to the leaching facilities and therefore cannot enter the brine disposal stream. The spent tri-ethylene glycol will be regenerated using a boiler which will operate using natural gas. Tri-ethlyene glycol dehydration is a standard method of removing any water vapour from a natural gas stream. Water in the gas may condense, and at high pressures may cause the formation of a hydrate, much like ice, that can plug piping systems even at room temperatures. Pipeline specifications therefore require the removal of excess water to a level below which hydrates can occur. In a glycol dehydrator, the gas passes through a trayed or packed vessel where it contacts very pure glycol, which absorbs the moisture. The glycol then flows to a regenerator, where it is heated to distil the absorbed water from it. This water usually comes off as steam and is vented as vapour. If the gas stream to be dehydrated contains substances such as benzene, toluene or xylene, these will be condensed and drained to a special waste tank, from which it will be transported to a refinery for processing, or to a suitable waste facility.

The amount of water that will be generated from the dehydrator is a function of the amount remaining on the walls of the cavern and the residence time for evaporation of this water. When first placed in service, there will be more water than will be available after a few injection/withdrawal cycles. As the cavern pressure declines with removal of stored gas, the amount of water that the gas can hold increases. At maximum, and for design purposes, the gas may contain about 0.034 m^3 of water per mmscf, and this would be reduced to 0.002 m^3/mmscf. At a flow rate of 135 mmscf per day, this would amount to about 4.59 m^3 per day. Typically this rate would occur for very little of the total production.

2.1.2.7 Emergency Shutdown Valves

An Emergency Shutdown Valve (ESV) will be installed at the wellhead on each of the piping connections to each well, in accordance with CSA Standard Z341. Should product arrive at the surface in the brine line, the pressure and the flow rate will increase which will activate a shutdown. These valves will also close in case of a rupture in any of the lines connected to the caverns. During brine intake and discharge, these valves will minimize a brine spill in case of piping rupture. Once the gas handling facilities are installed, these ESVs will serve to prevent fire or explosion on site if any of the gas lines to the caverns or tubular in the cavern well fail.

2.1.2.8 Scheduled Pressure Testing of Gas Storage Caverns

After the brining process and cavern development is complete, the brining equipment will remain in place. The caverns must be pressure-tested every ten years as per CSA Standard Z341. To pressure-test the caverns, the natural gas is displaced with water and then emptied. Thus, a supply of water is required, as is a method of disposal of the saline testing water. Since the caverns will be developed at different times and in order to avoid shutting down the entire facility, after ten years of initial operation, either one or two caverns will be pressure-tested every year. It is expected that six to eight weeks are required to pressure test one cavern.

2.1.3 Decommissioning

Should decommissioning be required, options include leaving pipeline structures in place, or removing them. If abandonment of the structures is chosen, it will be undertaken in accordance with the regulatory requirements applicable at the time of such activities. In the event the structures are dismantled/decommissioned, an abandonment plan and, if required, a site restoration plan, will be developed in consultation with the appropriate regulatory authorities.

At a minimum, an abandonment plan would include a schedule for equipment decommissioning and disassembly. The plan would indicate the approximate time required to remove and dispose all abandoned installations, structures, and buildings for which onsite reuse is not possible, and to reinstate the site to a quality necessary for subsequent industrial land use. Abandonment of the caverns themselves is covered in CSA Z341 and the requirements of this standard must, by Nova Scotia statute, be followed.

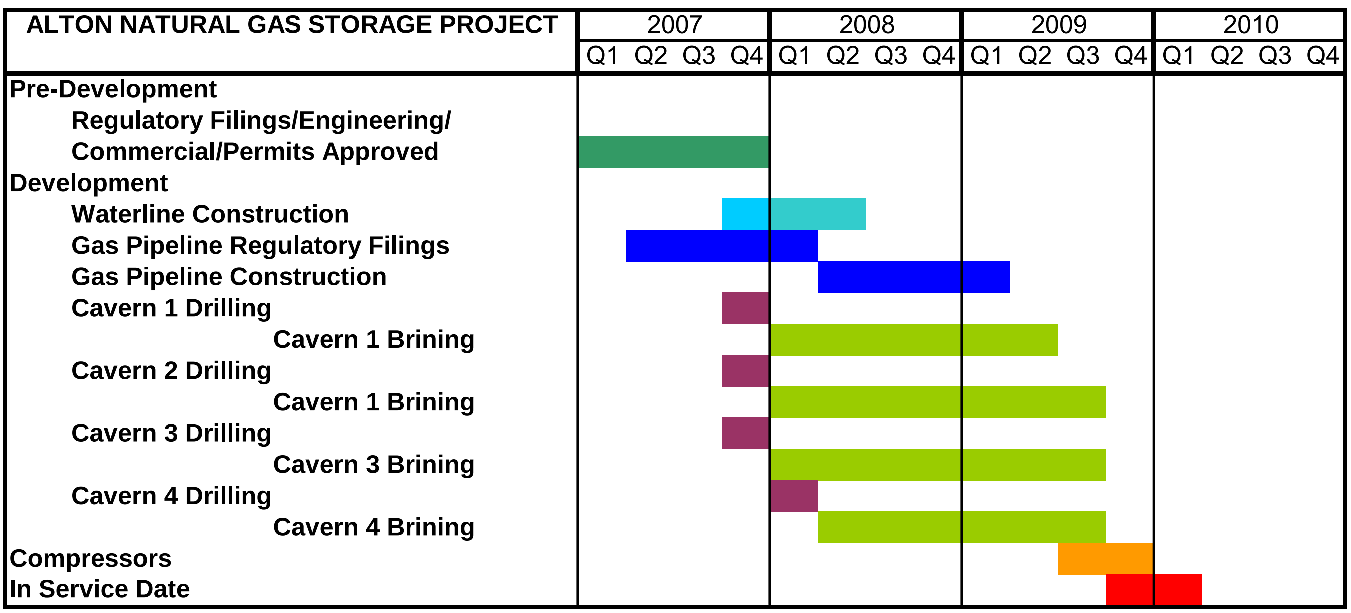
Decommissioning planning will be developed in consideration of environmental goals for the area. Activities that support such planning may include a review of baseline and follow up monitoring data; thorough record keeping; adherence to applicable standards and guidelines during Project operations; documentation of potential influencing factors; and development of a rehabilitation plan.

Disposal of waste will be conducted in accordance with Nova Scotia Environment and Labour (NSEL) waste management regulations and guidelines. Removal of buildings or structures is expected to have similar effects and considerations as construction and will be conducted in accordance with regulatory requirements applicable at the time of removal.

2.2 Project Schedule

Site preparation, installation of the pipelines and brine intake and discharge is expected to begin towards the end of 2007 and last for approximately three months. Four caverns of approximately 226,000 m^3 (60 m diameter by 80 m in height) will initially be formed. Cavern leaching is expected to take at least 18 to 24 months, starting in late 2007 or early 2008, with the potential of developing further caverns, or expanding existing caverns, in the future depending on market conditions. The Project may develop as many as 10 to 15 caverns resulting in the brining process lasting approximately 8 to 10 years. As individual caverns are completed, natural gas will be injected and withdrawn from the storage caverns to meet market demands. The storage caverns, pipelines and associated facilities will be designed, operated and maintained to provide service for a minimum of 50 years. There will also be a lateral gas pipeline linking the Alton facility with the M&NP Halifax Lateral. The overall proposed Project schedule is presented in Figure 2.5.

FIGURE 2.5 Proposed Project Schedule



2.3 Labour Requirements

The proposed facility will provide a significant number of construction jobs. It is anticipated that during construction of brining facilities, water pipelines and drilling four cavern wells, approximately 25 full-time equivalent positions will be created over the four-month construction period. At the peak of construction of brining facilities, water pipelines and drilling four cavern wells, the number employed will reach approximately 38. During construction of the gas storage surface facilities and pipelines, approximately 20 full-time equivalent positions will be created on average over the six-month construction period. At the peak of construction of the gas storage surface facilities and pipelines, the number employed will reach approximately 25.

During gas storage operation, it is anticipated that five to ten full-time equivalent positions will be required. This will include two or three office staff (to be located in Halifax), two full time gas plant technicians, and a plant engineer.

2.4 Emissions and Waste Discharges

The Project will meet or improve upon the compliance standards outlined in applicable regulations or standards with respect to brine disposal, other liquid and gaseous emissions and discharges, and waste management. Where no standards exist, best industry practices will be adopted, where feasible. Alton will minimize to the extent practical, volumes of wastes and concentrations of contaminants entering the environment. A Waste Management Plan (WMP) will be developed for all phases of the Project. The objective of this plan is to minimize waste discharges and emissions and identify appropriate waste reduction and other mitigative measures.

The Project will employ good engineering practices and standard industry controls to minimize the environmental impact from construction and operation.

2.4.1 Air Quality

Air quality impacts associated with construction activities are generally related to the generation of dust and routine emissions from the operation of construction equipment. Control measures, such as use of dust suppression techniques, will be used in construction zones as required to minimize the impacts from fugitive dust. The air emissions from the construction equipment will be localized and temporary, lasting the duration of construction activities. Routine inspection and maintenance of construction equipment will minimize exhaust fumes.

All air emissions will be maintained within the Nova Scotia Air Quality Regulations (*Environment Act*) and *Canadian Environmental Protection Act* Ambient Air Quality Objectives.

2.4.2 Noise Emissions

Project construction noise will be intermittent, as equipment is operated on an as-needed basis and mostly during daylight hours.

Noise emissions generated during construction and operations will not exceed the NSEL provincial guidelines at the property boundaries of the site:

65 dBA 0700-1900 hours;

60 dBA 1900-2300 hours; and

55 dBA 2300-0700 hours.

During operations, the compressors will be equipped with acoustically insulated buildings and Super Critical grade mufflers to attenuate the noise produced by the units. Additional sound attenuation and low-noise cooler fans will be installed as required to keep all noise produced by the compressors below the required range at the nearest residence. Pumps and the nitrogen compressor will be driven by electric motors producing minimal noise.

2.4.3 Wastewater Discharges

2.4.3.1 Brine Disposal

Water for cavern development will be drawn directly from the Shubenacadie Estuary, and saturated brine from the caverns will be diluted in the mixing pond, and returned to the Estuary downstream of the intake site, as described in Section 2.1 and in Appendix B. Alton has custom designed water intake and brine dilution and discharge facilities in recognition of high expectations for maintaining the environmental quality of the Shubenacadie Estuary system.

Spills, leaks, or accidental releases of brine during the brining process could adversely affect water quality including groundwater. A Spill Management Plan and Emergency Response and Contingency Plan will be developed and implemented to minimize the effects of spills on the terrestrial and aquatic environment including groundwater, and will also include mitigation measures to minimize impact if a spill occurs and reaches a waterbody. This is further addressed in the Malfunctions and Accidental Events Section (Section 7.0).

2.4.3.2 Surface Run-off

There is potential for erosion and sedimentation of freshwater systems associated with land-based construction activities. An Environmental Protection Plan (EPP), including plans for erosion and sediment control measures will be developed prior to commencement of construction activities and implemented to minimize impacts to water quality from construction activities. These measures will include, but are not limited to:

- schedule site activities to minimize the disturbance of the Project surface area;
- avoid maintaining open excavations for prolonged periods and compact loose materials;
- compact soils as soon as excavations, filling, or levelling activities are complete;
- install silt fences, hay bales, *etc*. to minimize the transport of silts;
- implement measures to control sedimentation and erosion, and to ensure that construction personnel are familiar with these practices and conduct them properly; and
- control runoff during the construction phase.

Wastewater will be sampled and tested for suitability prior to use and prior to discharge. If treatment is necessary, procedures will be developed for treating the water prior to discharge.

2.4.4 Solid and Hazardous Waste

Potential sources of nonhazardous or solid wastes generated by Project activities include typical construction wastes such as wood, scrap metals, insulation waste, packing/crating materials, and domestic wastes. Scrap paper and other office wastes will also be generated. These wastes will be segregated as recyclable and non-recyclable, with recyclable material collected and transported to a licensed recycling facility using authorized local services. An effort will be made to minimize the amount of waste generated by application of 4-R principals (reduce, reuse, recycle, recover) to the extent practical. Waste management procedures will be outlined in the Waste Management Plan (WMP) and comply with provincial solid waste management regulations as well as additional municipal and disposal facility requirements. Non-recyclable wastes will be transported offsite to a permitted landfill.

Hazardous waste that is expected to be generated from Project construction and operation sources will be minimal and will include small quantities of waste oils, spent chemicals (primarily triethylene glycol), cleaning rags, and other filter elements. Hazardous waste will be stored onsite in a separate temporary hazardous waste storage area provided with full containment. Hazardous wastes will be removed from the site by a licensed contractor and recycled or disposed at an approved facility. Other control measures for hazardous waste include developing and implementing Spill Management Plan and Emergency Response and Contingency Plan to avoid impacts from release of potentially hazardous materials.

2.5 Environmental and Safety Protection Systems

Historically, storage of hydrocarbons in salt caverns and underground formations has been the safest and most secure method of storage. The concept of storage using caverns created in salt deposits originated in Canada in the 1940s, and there has been storage using this method in Canada and the USA since the early 1950s. One of the most significant factors contributing to the safety of cavern storage in Canada is the mandatory requirement by all Canadian jurisdictions that design and operation of cavern storage facilities conform to the requirements of CSA Standard Z341, *Storage of Hydrocarbons in Underground Formations*. The Technical Committee responsible for this standard investigates every pertinent incident worldwide and reviews the latest relevant technology, to ensure that the standard covers all potentially hazardous situations. CSA Z341 is the standard specified by the Nova Scotia Code of Practice Respecting the Underground Storage of Hydrocarbons. It is the only such standard worldwide, and is specified and/or copied in many jurisdictions.

There have been very few incidents of failures or accidental releases in the underground storage industry in Canada. World-wide, they occur in situations where the facility did not comply with the requirements of CSA Z341. An incident occurred at Yaggy, Kansas, in 2001, due to an undetected hole in a well cemented casing, and exacerbated by the fact that no individual cavern flow measurement was performed and no product inventory records kept and coordinated with cavern pressures. The caverns had no individual Emergency Shutdown System, and very little in the way of safety monitoring and control equipment. Leaked gas flowed underground in a poorly understood geological formation until it came to surface approximately 12 km away in a populated area. Two people were killed, and a number were injured and/or evacuated from their homes until the situation was brought under control. The entire facility remains shutdown.

An incident occurred at the BP cavern site in Ft. Saskatchewan, Alberta, in an ethane storage cavern when a surface pipe connected to the wellhead ruptured as a result of undetected corrosion and piping stress. There was a significant loss of product in the ensuing fire and minor damage to surface facilities, but no serious injuries were reported. It was not realized prior to the incident that the configuration of the particular line that failed was in contravention of the requirements of CSA Z341, and BP has since corrected all their caverns to comply.

Another incident occurred at Moss Bluff, Texas, in August, 2004, when corrosion in the internal tubulars and surface piping during leaching operations to expand the cavern went undetected and led to a failure and fire. Again, there was product loss and damage to the wellhead and immediate surface facilities, but no injuries. The corroded parts were replaced and the system was back in service soon after the incident.

The most common cause of incidents is from undetected corrosion in the wellbore, wellhead or surface piping, aggravated by poorly designed control and safety systems and/or poor operating procedures. CSA Z341 recognizes that corrosion may be an important factor in cavern system failures, and therefore addresses this issue in a number of sections. For example, casing inspection logs capable of identifying corrosion are required before placing the system in service, and every 10 years thereafter. Where a cavern well passes through a potentially corrosive zone, a special completion is required with extra tubing creating an annulus that is filled with a corrosion inhibiting fluid. A full section, Section 8.4, is devoted to Corrosion Control requirements, and includes the use of impressed-current cathodic protection systems. CSA Z341 specifies that corrosion control monitoring shall conform to a further standard, NACE RP0186.

Surface piping and equipment is more accessible, and therefore easier to monitor for corrosion. In gas plants and facilities such as the Alton project, this is normally done by the use of ultrasonic thickness tests and the evaluation of corrosion coupons; these items will be used in the Alton project. Weekly visual inspection of all components will be used to monitor external corrosion, and special materials or coatings will be employed where they can be effective. Alton intends to install and use a de-aerator to reduce the oxygen level in the intake water to reduce internal corrosion in the piping, vessels and wells. In addition, corrosion allowances will be incorporated into the design of all these components. Regular testing will also be employed to check for a number of potential problems, including corrosion.

The proposed Project will meet or exceed the requirements of CSA Z341 which will eliminate or greatly reduce any of the above incidents from occurring. The Nova Scotia *Underground Hydrocarbon Storage Act* requires that the Alton project follow CSA Standard Z341.2 Salt Cavern Storage. This standard provides the minimum requirements for the design, construction, operation, maintenance, abandonment, and safety of hydrocarbon storage in underground formations and associated equipment. In accordance with the standard, all materials and/or equipment used to construct the underground storage system or becomes part of the underground storage system will either comply with or exceed the requirements and only be used provided there is technical data to ensure that they are safe.

The standard for the location of underground storage facilities is clearly defined and Alton plans to exceed this standard by providing additional space between each cavern and wellhead. It has also chosen a site which is optimal for development and operation due to its proximity to rights-of-way and geological formation. The Alton project has already met or exceeded and will continue to meet or exceed all design and development criteria including risk assessment, assessing neighbouring activities, geological studies, map creation, fluid compatibility, subsidence and operation limits. When completing the wells, Alton will meet or exceed all standards covered within the core requirements, casing requirements, cementing requirements and conversion requirements.

Surface facilities will be designed and constructed in accordance with the requirements of ASME Standard B31.3, Process Piping, and the appropriate sections of the ASME Boilers and Pressure

Vessels Code. Pipelines will be designed and constructed in accordance with CSA Standard Z662, Oil and Gas Pipeline Systems. To date, there have been no reported Canadian incidents with a company that has followed CSA standards.

2.5.1 Emergency Shutdown Valves

In the Alton Natural Gas Storage Project, the largest accumulation of hazardous material is the natural gas that is contained in the underground storage facility and constitutes a substantial fuel source. As long as this gas remains in the underground storage facility, it is not a concern, as oxygen and a heat source are unavailable to create conditions suitable for combustion. The hazard occurs if and when natural gas is accidentally released. Much of the safety effort is therefore directed towards eliminating any possible loss of containment, and secondly to reduce the amount of loss. The response in case of any emergency is for the Emergency Shutdown Valves (ESVs) located at each wellhead to immediately and automatically engage. If the emergency is a fire or potential fire, this will close off the main source of fuel. A second potential hazard is for pressure to increase in the brine system, which normally operates at low pressure. The standards address this issue, and require the use of ESVs on all lines connected to the wellhead. Instruments will be installed to detect a problem and initiate a shutdown.

Potential hazards are thoroughly identified in the applicable standards so that they may be addressed with corrective designs, controls or operating procedures. The design and implementation of this facility will ensure that it meets the best current standards of safety available worldwide.

2.5.2 Meter Station

As per CSA Standard Z341, there will be a meter station to measure gas flow to and from each well, as well as the total flow from and to the pipeline. Measurement of the pressure and the volume of gas contained in inventory in each cavern is a critical component of the safety systems. The volume in inventory is expected to develop a unique pressure for each cavern depending on the actual size of that cavern. Any anomaly will raise an immediate alarm, as it may be indicative of a leak in the system. The meter station is described in Section 2.1.

The water and brine systems will include measurement and control systems to monitor the volume entering each pipeline and compare it with the volume exiting. Should there be a small total change in flow volume on the intake line from the river to the underground storage facility, an alarm will be raised. A slightly larger change will initiate an automatic system shutdown. Should there be a 1% change in flow volume on the discharge line from the underground storage facility to the brine holding and mixing ponds, an alarm will be raised. A small change will initiate an automatic system shutdown. The waterlines will be tested routinely for decreases in pressure. The brine pond will be equipped with a level sensing device that will provide an indication of the volume of brine in the pond. This will provide a signal that will be integrated with the in-flow and out-flow of brine, so that the volume in storage based on flow can be compared with the volume based on level, and an alarm raised if there is a discrepancy.

2.5.3 Facility Safety

2.5.3.1 Prevention Measures

In Canada, underground salt cavern storage has a long and outstanding safety record. The industry has been able to maintain this excellent record because of the effort that has been devoted to development and implementation of: safe designs; operating procedures; safety features such as leakage prevention, automatic hazard detection and emergency isolation and shutdown provisions; and fixed and mobile equipment for monitoring, fire control and extinguishment.

The principal standards used in underground development and storage are the CSA Standard Z341 *Storage of Hydrocarbons in Underground Formations*. Surface facilities will comply with the requirements of ASME B31.3, and pipelines will comply with the requirements of CSA Standard Z662, Pipeline Systems. Industry codes and standards specify, among many other details, the design items to ensure safe development and operation. These codes are continually being updated to reflect new concerns and technology advancements. Safety manuals will be prepared as part of the engineering services for the Project. They will detail operating and maintenance procedures as well as emergency procedures.

The gas storage site will utilize a set of natural gas driven compressors and dehydration packages to inject and withdraw gas once the caverns are in operation. These gas storage compressors and dehydration packaged equipment will be mounted on structural steel skids complete with buildings. To contain any spillage of process fluids or lubrication oils the skids will be equipped with containment or “drip” lips around their entire perimeter or alternately around specific items of rotating equipment to contain possible lube oil or fluid leaks. In addition, as a means of detecting an accidental leakage of natural gas inside the buildings, gas detectors will be provided in each process building. If a leak is detected above 20% of the Lower Explosive Limit (LEL) an alarm is sounded and if the leak exceeds 40% of the LEL for methane an Emergency Shutdown (ESD) will be initiated automatically. To protect against the possibility of a fire, the buildings will also be equipped with fire detectors. Should a fire be detected an ESD will also be initiated automatically. The compressors and dehydration packages will each be equipped with pressure and temperature measurement sensors to protect against any over or under pressure/temperature situations. To ensure a redundant system for safety, the alarm and control sensors and activating equipment will be separate from the shut-down sensors and equipment. In addition to these first two lines of defence, there will be over and under pressure relieving devices provided for all pressure vessels and tanks. The vents from all relief valves will be piped to a vent stack away from the facility and any ignition source. The vent stack will be high enough to disperse any vapours. If an ESD is initiated there will be Emergency Shutoff Valves (ESV’s) located at the site boundary to block off the site from the sales pipeline. These ESV’s are in addition to the valves mounted on the wellheads on the caverns as specified in CSA Z341.

Regular inspection and preventative maintenance are among the most important functions that can be performed in an underground storage facility, or any process plant, to prevent the unlikely event of gas being accidentally released. The probability of an incident occurring at the Alton storage site is very low, but there have not been enough incidents in Canada to generate appropriate statistics to evaluate the probability. Once the Project design is finalized, comprehensive inspection and maintenance procedures will be developed for use in this facility. A comprehensive risk review and hazardous operations (Hazops) study as outlined in CSA Standard Z341 Annex D will be performed on this Project, and will include the following components:

- definition of objectives;
- hazard identification;
- frequency analysis;
- consequence analysis;
- risk estimation;
- risk evaluation;
- risk significance; and
- options analysis.

Emergency procedures to mitigate adverse effects and protect life and property in the event of an incident will also be prepared after careful study of potential hazards and thorough evaluation of the best way to handle each hazard.

2.5.3.2 Environmental Management Plan

A Project-specific Environmental Management Plan (EMP) will be prepared to provide the required procedures to adhere to regulatory obligations. In addition, required protection measures will be provided for activities conducted on site to ensure the health and safety of workers on-site.

The purpose of the EMP is to:

- ensure that the company's commitments to minimize environmental effects in general, and specific regulatory commitments, will be met;
- provide concise and clear instructions regarding procedures for protecting the environment, and minimizing potential environmental effects;
- document environmental concerns and appropriate protection measures associated with Project operations;
- provide a reference document for planning and/or conducting specific activities which may have an effect on the environment;
- function as a training document/guide for environmental education and orientation; and
- communicate changes in the program through the revision process.

Environmental management is considered an integral element in the way daily operations are performed and Alton is committed to upholding this position while complying with applicable laws, regulations, and internal standards. Alton will develop an EMP in order to communicate this commitment as well as detailed Project requirements for environmental management to staff, contractors, regulatory agencies, and the public. By first ensuring that working conditions promote an atmosphere of health and safety for all employees, employees will then incorporate the environmental management practices into their daily work routine. The EMP will be used during construction and normal operating conditions at the site.

A sample table of contents for a typical EMP is shown below:

Environmental Management Plan Table of Contents

6.1.1 Groundwater Quality Monitoring
6.1.2 Surface Water Quality Monitoring
6.1.3 Noise Monitoring
7.0 Complaint Resolution Program
8.0 Contingency Plans
8.1 Spills
8.1.1 Scope of the Program
8.1.2 Environmental Issues
8.1.3 Relevant Regulations, Guidelines, and Commitments
8.1.4 Contingency Procedures
8.1.5 Training Requirements
8.1.6 Records
8.1.7 References
8.2 Fires
8.3 Heritage and Archaeological Discovery
8.4 Erosion Control Failure
8.5 Transportation Safety
9.0 Contact List and Incident Reporting
9.1 Contact List
9.2 Incident Reporting Procedures

The EMP will serve as an umbrella document that includes information such as the WMP, EPP and the Emergency Response and Contingency Plan, as well as other key environmental planning documents.

2.5.3.3 Emergency Response and Contingency Plan

A Project-specific Emergency Response and Contingency Plan for unplanned events will be prepared. A Spill Management Plan will also be developed to prevent and respond to smaller spills. In the case of an accidental release of materials from the facility, reporting and clean-up procedures will follow provincial emergency spill regulations as required. Lubricants and other petroleum products will be stored and waste oils will be disposed of in accordance with provincial regulations. Small spills will be contained by on-site personnel using spill kits kept at the site.

Typical elements of the Emergency Response and Contingency Plan include:

- purpose and scope of plan coverage;
- general facility identification information (*e.g.,* name, owner, address, key contacts, phone number);
- facility and locality information (*e.g.,* maps, drawings, description, layout);
- discovery/initial response;
- sustained action;
- termination and follow-up actions/prevention of recurrence;

- notification (internal, external, and agencies);
- response management system (*e.g.,* incident commander, safety, liaison, evacuation plan);
- assessment/monitoring, discharge or release control, containment, recovery, and decontamination;
- logistics – medical needs, site security, communications, transportation, personnel support, equipment maintenance and support, emergency response equipment (*e.g.,* PPE, respiratory, fire extinguishers, first aid);
- incident documentation (accident investigation and history);
- a description of biological and human-use resources that could be impacted;
- an inventory of oil and chemical products and associated storage locations for both Project construction and operational phases;
- the identification of spill response equipment that will be on-site or available in case of emergency events;
- procedures for responding to operational spills and releases;
- an incident reporting system, including notification and alerting procedures;
- a list of responsible organizations and clarification of the roles of each organization;
- clean-up and disposal procedures;
- training and exercises/drills;
- plan review and modification;
- prevention; and
- regulatory compliance.

The Emergency Response and Contingency Plan will also reference the CAN/CSA Standard Z731-03 *Emergency Preparedness and Response* Standard to supplement code requirements as applicable in the development of the Emergency Response and Contingency Plan. Alton commits to submitting the Emergency Response and Contingency Plan to appropriate regulatory agencies for review.

The capacity of local fire and/or ambulance services to respond to incidents will be evaluated. Alton will work closely with related agencies on the issue of public safety. All staff will complete Workplace Hazardous Materials Information System (WHMIS) training. Alton will develop a comprehensive Environmental, Health and Safety (EHS) system that encompasses internal requirements for employee safety and environmental reporting.

2.6 Community Benefits

In addition to creating jobs through the construction and operation of the facility (see Section 2.3), the Project is expected to continue contributing to the community by:

In addition to direct employment, the Project is expected to contribute to the community by:

- bringing gas closer to the communities of Alton, Brookfield, Stewiacke, and Truro through the development of a gas pipeline to the Alton facility;
- decreasing gas price volatility for Nova Scotia gas customers;

- decreasing gas price volatility and hence power price volatility for natural gas fired power generation;
- to the extent that stable gas prices result in greater gas fired power generation and hence less coal fired generation, a potential reduction in green house gas emissions;
- increasing regional security of supply levels;
- contributing to the tax base (income, property, and sales);
- allowing for the potential of developing other energy-related projects as a result of storage; and
- contributing to the overall economic growth of the community.

Projected costs of initially developing the facility to a capacity of 4 bcf of gas storage are estimated at $60 million, to be expended over the next several years. This Project will be 100% privately funded. Alton Natural Gas Storage L.P. is committed to using local resources where possible.

2.7 Project Alternatives

Alternatives to the Project location and current design to discharge brine were considered. The current location of the Alton Project is ideal because of the presence of the salt formation, the proximity of a water source for solution mining, and the proximity of the M&NP Halifax Lateral gas pipeline. Several alternatives to discharging brine into the Shubenacadie River were investigated including: discharging in Cobequid Bay; underground injection of the brine; selling brine to salt producers; supplying brine for winter maintenance of roads; and producing salt.

Running the discharge pipeline to Cobequid Bay was considered; however, the discharge pipeline would have to be installed several kilometres into the Bay. This distance from the site (approximately 40 km) and the cost and difficulty of building a brine diffuser in such a dynamic environment were predicted to be technically and economically not feasible.

In some inland areas of North America, brine is injected into deep porous rock formations which already contain saline water. The rock must have sufficient porosity and permeability to accept a large flow rate of brine. In addition, the formation must be large enough to accept a large volume of brine with no chance of upward fluid migration. In Canada, this method is used in Alberta and Saskatchewan. A study was conducted by Hitchner Exploration Services Limited of Calgary to investigate the possibility of deep brine injection in the Alton area (Appendix E). Analysis of available well log data from Alton-06-01, Alton-99-01 and Cloverdale #1 and comparison with known injection wells suggested that there are no potential zones that are realistically capable of being used for brine injection in any of the three wells.

Sale of brine to producers (*i.e.*, Sifto Canada Corp. and the Canadian Salt Company Ltd.), supply of brine to provincial and municipal users for winter maintenance of roads and producing evaporated salt for commercial sale were investigated. The results of the investigation are included in Appendix F and summarized as follows:

- Evaporation facilities at Sifto Canada Corp. and the Canadian Salt Company Ltd. consume saturated brine at an average combined rate of 1,560 m^3 /day. Cost of brine generation is low while brine quality and supply are well-established and secure. Freight cost for delivering brine from Alton to producers is estimated at up to 13 times the cost of brine produced on-site.

- Use of brine within Nova Scotia for pre-wetting highways during the winter season is being encouraged due to the efficiency of application and relatively lower salt use. Total consumption in the province is expected to reach a maximum of 2,200 to 2,800 m^3 /year. The potential market for Alton brine as a pre-wetting supply is very small and represents less than one day of Alton production per year.
- A scenario of building an evaporator plant complete with downstream equipment and storage was considered. On a capital and operating cost basis alone, such a facility cannot compete with the established producers. In addition, the current markets are over supplied and volumes such as those contemplated from Alton are excessive when compared even to national volumes for evaporated salt.

Overall, these commercial options were not found to be feasible as a brine disposal option for the Project.

Several brine discharge configurations were investigated, including a multi-port diffuser line in the Estuary, a single port outlet discharging brine diluted by Estuary water, and a brine mixing pond adjacent to the Estuary. For technical and environmental reasons, a brine mixing pond is proposed as the ideal solution for the discharge of brine into the Estuary. Brine dispersion modeling results for each of these scenarios is included in Appendix C.

3.0 SCOPE AND METHODOLOGY

3.1 Environmental Assessment Methodology

The environmental assessment methodology for the Project has been developed to satisfy regulatory requirements of a Class I Registration under the Nova Scotia *Environment Act* and Environmental Assessment Regulations.

The methodology used in this report has evolved from methods proposed by Beanlands and Duinker (1983), who stressed the importance of focusing the assessment on environmental components of greatest concern. In general, the methodology is designed to produce an environmental assessment document that:

- is focused on issues of greatest concern;
- addresses regulatory requirements;
- addresses issues raised by the public and other stakeholders;
- integrates engineering design and mitigative and monitoring programs into a comprehensive environmental management planning process; and
- integrates the effects assessment into the overall assessment of residual environmental effects.

The environmental assessment methodology for this Project includes an evaluation of the potential effects of each Project phase – construction, operation and maintenance, as well as malfunctions and accidents, with regard to Valued Environmental Components (VECs) and Valued Socio-economic Components (VSCs). Project-related effects are assessed within the context of temporal and spatial boundaries established for the assessment.

3.1.1 VEC and VSC Selection

An important part of the assessment process is the early identification of VECs and VSCs upon which the assessment can be focused for a meaningful and effective evaluation. Issues scoping is an important part of the VEC and VSC identification process. The issues scoping process for this assessment included:

- regulatory review of the draft Project Description and other informal discussions regarding potential environmental interactions with Fisheries and Oceans Canada (DFO), Environment Canada, NSEL, Nova Scotia Museum, Nova Scotia Department of Natural Resources (NSDNR), and Nova Scotia Department of Agriculture and Fisheries;
- review of relevant provincial and federal websites (*e.g.,* NSDNR, Environment Canada);
- review of listed species and/or species-at-risk found within the Project area using existing regional information and/or site surveys;
- discussions with government scientific authorities (*e.g.*, NSDNR species-at-risk experts, DFO biologists);
- preliminary environmental investigations conducted by Alton environmental and engineering consultants;

- open house public meeting held by Alton in Brookfield on November 22, 2006 and subsequent comments received as part of the ongoing public consultation process;
- consultation with stakeholders; and
- the professional judgement of the Proponent's Study Team.

Section 4.0 of this report provides an overview of the public consultation program undertaken by Alton in relation to this environmental assessment, and for general public information. Information from this process assisted the identification and scoping of VECs and VSCs for the environmental assessment. Alton's ongoing consultation program involves continued communication with stakeholders and regulators during the application review and post application follow-up process.

The scoping exercise considered relevant federal, provincial and municipal regulations and guidelines. Regulatory issues and concerns have also been identified through various communications and meetings held by Alton and the Study Team with representatives of relevant regulatory authorities.

Preliminary research included a review of relevant scientific research publications and regulatory documents. Also included in issues scoping were preliminary field investigations (to assist with facility siting) and preliminary stakeholder consultations. The informed professional judgment of the environmental assessment Study Team and Alton staff was also an important component of the issues scoping exercise.

The environmental issues considered are shown in Table 3.1, along with the rationale for inclusion/exclusion as a VEC or VSC.

TABLE 3.1 Selection of Valued Environmental and Socio-economic Components

Environmental Issue	Scoping Considerations	Selected VEC/VSC
Air Quality	Project activities are expected to result in minor emissions (*e.g.,* pumping and compressing). Limited construction equipment exhaust will be addressed by limiting idling and implementing appropriate dust control. Routine inspection and maintenance of construction equipment will minimize exhaust fumes. Pumps and the nitrogen compressor will be driven by electric motors producing no emissions locally. Air quality will not be considered as a VEC.	N/A
Acoustic Environment	Project activities are expected to result in minor noise emissions (*e.g.*, pumping and compressing). Project construction noise will be intermittent, as equipment is operated on an as-needed basis and mostly during daylight hours. Noise emissions generated during construction and operations will not exceed the NSEL provincial guidelines at the property boundaries of the site. Pumps and the nitrogen compressor will be driven by electric motors producing minimal noise. Acoustic Environment will not be considered as a VEC.	N/A
Water Quality	Water quality is inherently linked to habitat quality for aquatic species. Public and professional concern exists regarding species of special status protected under the *Species-at-Risk Act* and associated habitat that may occur in the area. Provisions for discharging into aquatic environments also exist under the *Fisheries Act.*	▪ Fish and Fish Habitat

TABLE 3.1 Selection of Valued Environmental and Socio-economic Components

Environmental Issue	Scoping Considerations	Selected VEC/VSC
Soil Capability and Quality	Agricultural lands will be reinstated after pipeline installation and agricultural operations can continue on lands over the RoW. Risk to soils due to brine leak is addressed in malfunctions and accidental events section.	▪ Malfunctions and Accidental Events
Fish and Fish Habitat	Fish and fish habitat are protected by the federal *Fisheries Act*. Species at risk are protected under the *Species-at-Risk Act* (*e.g.*, Inner Bay of Fundy population of Atlantic salmon). Public concern exists for freshwater fish and fish habitat in the area. Fish habitat in the vicinity of the Project area supports commercial, recreational and Aboriginal fisheries.	▪ Fish and Fish Habitat
Vegetation	Species of special concern are protected under the *Species-at-Risk Act* and Nova Scotia *Endangered Species Act*. The focus of concern is on protection of species biodiversity and unique or uncommon habitats.	▪ Rare and Sensitive Flora
Mammals	Regulatory protection for mammals exists under the *Species-at-Risk Act*, Nova Scotia *Endangered Species Act*, Nova Scotia *Wildlife Ac*t and the federal *Fisheries Act*. Scientific and public concern exists for rare species as well as habitat that is important to mammal species, such as deer wintering areas.	▪ Wildlife and Wildlife Habitat
Amphibians and Reptiles	Protection of species biodiversity is administered through the *Species-at-Risk Act,* Nova Scotia *Endangered Species Act* and Nova Scotia *Wildlife Act*. The focus of concern is on rare species. Scientific concern is that rare amphibian and reptile species are at risk from development since large proportions of their populations can be affected by even relatively small perturbations if the population is very small and concentrated in a small area.	▪ Wildlife and Wildlife Habitat
Birds and Bird Habitat	Protection of migratory species and species of concern are mandated by the *Migratory Birds Convention Act*, *Species-at-Risk Act*, Nova Scotia *Endangered Species Act* and Nova Scotia *Wildlife Act*. The focus of concern is on protection of species diversity, migratory and non-migratory birds, rare or sensitive species potentially feeding, breeding, moving and/or migrating through the Project area and their habitat.	▪ Wildlife and Wildlife Habitat
Species-at-risk	Protection of species biodiversity is administered through the *Species-at-Risk Act*, Nova Scotia *Endangered Species Act*, Nova Scotia *Wildlife Act* and *Migratory Birds Convention Act*. Species-at-risk are discussed within their relevant environmental component. The Project interactions potentially affecting a rare terrestrial plant species are very different from those affecting rare bird species or a rare fish species, and are thus more meaningfully discussed within their respective VEC sections.	▪ Fish and Fish Habitat ▪ Wildlife and Wildlife Habitat ▪ Rare and Sensitive Flora

TABLE 3.1 Selection of Valued Environmental and Socio-economic Components

Environmental Issue	Scoping Considerations	Selected VEC/VSC
Water Usage	Surface and groundwater usage are important in the hydrologic cycle and ecological function (*e.g.*, surface water discharge), as well as important as a water supply, particularly to rural users. Interaction with surface water will be limited because the Proponent has committed to directionally drilling under all streams. No water extraction from groundwater resources for the development of the caverns will occur and blasting is not associated with this Project. Approximately 60 water supplies are located within 500 m of the pipeline. Interaction between groundwater wells and gas leaking due to failure of a cavern is unlikely because the proposed caverns are much deeper than the maximum depth of potable ground water, and the intervening strata contain 380 m of additional impermeable salt, the physical properties of these salt formations make it unlikely to fracture, and safety systems and standards will minimize potential risks to groundwater users. A failure of a cavern well is also unlikely because these wells will have surface casing cemented to a depth of 100 m, which is below the depth of potable groundwater. Safety systems and standards (CSA Z341) will minimize potential risks to groundwater users through approved cavern design. Interactions due to malfunctions and accidental events (*i.e.*, brine leak and failure of caverns) will be addressed in this section.	▪ Malfunctions and Accidental Events
Surface Water Resources	Surface water resources in terms of water quality are inherently linked to habitat quality for aquatic species. Protection of species biodiversity is administered through the *Fisheries Act*, *Species-at-Risk Act*, Nova Scotia *Endangered Species Act.*	▪ Fish and Fish Habitat
Wetlands and Wetland Functions	Wetlands are an important habitat type often associated with high species diversity including species-at-risk. The Proponent has committed to avoiding wetlands where feasible; therefore, there is limited potential for interaction. Should wetlands be determined to be unavoidable upon final design of pipeline routing and location of dilution ponds and other aboveground structures, full wetland evaluations will be conducted according to provincial policy and guidelines, and permit applications submitted with habitat compensation proposals. Wetlands will not be considered as a VEC.	N/A
Land Based Archaeological and Heritage Resources	Land based archaeological and heritage resources are administered under the Nova Scotia *Special Places Protection Act*. Concerns exist with the effective management of archaeological and heritage resources.	▪ Archaeological and Heritage Resources
Land and Resource Use for First Nations and Aboriginal Peoples	First Nations current use of Lands and Resources is included as a VSC in this assessment in recognition of the potential interest of First Nations traditional use of land and resources.	▪ Traditional Land and Resource Use
Fisheries and Aquaculture	Fisheries and aquaculture are administered under the Nova Scotia *Environment Act* and the federal *Fisheries Act*. They are considered a VSC due to their importance to the regional economy and importance as a socio-cultural activity among maritime communities.	▪ Fisheries Resources
Land Use	It is important to consider the compatibility of the Project with existing land uses, municipal land use plans and zoning designations.	▪ Land and Resource Use
Public Health and Safety	Concern exists for human health and safety in communities surrounding the facility in the event of a malfunction or accidental event.	▪ Malfunctions and Accidental Events
Community Services and Infrastructure	This issue will be considered in the context of ensuring local capacities and response capabilities (fire, medical and police) and on-going support services (health and social services).	▪ Land and Resource Use ▪ Labour and Economy
Economic Development	Economic development is a fundamental socio-economic determinant and is related to increased economic activity related to the Project.	▪ Labour and Economy

The following environmental components, selected as a result of issues scoping, are addressed in greater detail in Section 6.0:

- Fish and Fish Habitat;
- Rare and Sensitive Flora;
- Wildlife and Wildlife Habitat;
- Land and Resource Use;
- Labour and Economy;
- Fisheries Resources;
- Traditional Land and Resource Use; and
- Archaeological and Heritage Resources.

3.2 Outline of the Environmental Effects Assessment

This section provides an outline and overview of each of the subsections containing the assessment of environmental effects.

3.2.1 Boundaries

An important aspect of the effects assessment process is the determination of the boundaries of the assessment. Temporal and spatial boundaries encompass those periods during, and areas within which, the VECs/VSCs are likely to interact with, or be influenced by, the Project. Administrative and technical boundaries, which address the limitations on the scope of, or approach to, work during the assessment of environmental effects, have also been considered for the assessment.

The temporal boundaries considered for this assessment include the construction and operation life of the Project. Spatial boundaries for the assessment vary according to the VEC/VSC but are generally limited to the immediate Project area unless otherwise noted. For example, effects on migratory birds may include a more regional perspective, while effects on rare flora are limited to populations in the immediate Project area (*i.e.,* “footprint” and adjacent land). The temporal and spatial boundaries for each VEC and VSC are described in Section 6.0. Administrative boundaries discussed in the assessment define the administrative/political/regulatory considerations for the assessment of the VEC/VSC (*e.g.*, relevant jurisdictions, legislation) while technical boundaries define technical factors which may have imposed constraints on the assessment (*e.g.*, availability of data, time).

3.2.2 Description of Existing Conditions

Existing conditions (*i.e.,* pre-Project) are described for each VEC and VSC. The description is restricted to a discussion of the status and characteristics of the VEC/VSC within the boundaries established for the assessment. In order to improve the focus of the assessment, the description centres on aspects that are relevant to potential Project interactions.

3.2.3 Residual Environmental Effects Evaluation Criteria

For this assessment, significance is specifically defined and determined for each environmental component and is defined based on information obtained in issues scoping, available information on the status and characteristics of the environmental component, existing standards or regulations, and professional judgment.

3.2.4 Potential Interactions, Issues and Concerns

Potential Project interactions with VECs and VSCs are described in the assessment through a description of the degree to which VECs and VSCs are exposed to each Project activity. Where appropriate, the assessment includes a summary of major concerns or hypotheses of relevance regarding the effect of each Project activity on the VECs/VSCs being considered. Where existing knowledge indicates that an interaction is not likely to result in an effect, certain issues may not warrant further analysis.

3.2.5 Analysis, Mitigation and Residual Environmental Effects Prediction

The assessment focuses on the evaluation of potential interactions between the VECs/VSCs and the various Project activities outlined in the Project description. Residual environmental effects are those that remain after mitigation and control measures are applied.

The effects evaluation for each VEC/VSC is conducted by Project phase (*i.e.*, construction and operation) and for malfunctions and accidental events. For each phase, the Study Team selects those Project activities that may result in a positive or adverse effect. To determine if there are adverse effects, the Study Team considers a number of factors including:

- magnitude;
- geographic extent;
- duration;
- frequency;
- reversibility; and
- context.

These evaluation criteria are defined and described in greater detail for each environmental component, where applicable.

In general, the prediction of residual environmental effects follows three steps:

- determining whether environmental effects are adverse;
- determining whether adverse environmental effects are significant; and
- determining whether the significant adverse environmental effects are likely to occur.

During the evaluation, the definition of significance is applied to any residual adverse environmental effects that have been identified. As a result, residual adverse environmental effects are predicted to be either **significant** or **not-significant**.

3.2.6 Follow-up and Monitoring

Recommendations for follow-up studies or monitoring activities are included, where appropriate.

3.2.7 Summary of Residual Environmental Effects Assessment

Finally, the residual environmental effects on each VEC and VSC by Project phase are summarized.

4.0 PUBLIC INVOLVEMENT

Consultation with potentially affected stakeholders, the general public and regulatory agencies is an important component of Project planning and scoping. Consultation is directed at providing information to and obtaining feedback on the Project, particularly the location, design, construction and operations and maintenance procedures. Public involvement for the Project includes:

- meetings with regulatory agencies;
- public announcements and solicitation of comments through a website and e-mail address;
- meetings with potentially affected landowners and other stakeholders;
- input from Aboriginal peoples; and
- open house sessions.

Consultation will continue as the Project proceeds through the approvals process, as well as through the planning, construction, and operations phases. For example, this EA Registration will be made available to the public as part of the requirements under the Provincial EA process and comments regarding the Registration will be collected and reviewed by NSEL.

4.1 Public and Stakeholder Consultations

Public and stakeholder consultations for the Project to date specifically included:

- Project updates
- solicitation of comments via a website www.altongas.com;
- a presentation in Brookfield to the regional business community; and
- a public open house session in Brookfield.

Two press releases were issued on January 2, 2006 and May 16, 2006 describing the Project activities to date which included progress on seismic and drilling activities as well as a description of the Project (Appendix G). The Project website (www.altongas.com) was launched on August 3, 2006 to inform and solicit comments from the public. The website will continue to be updated as the Project proceeds.

On October 12, 2006 Alton held a presentation at the Don Henderson Sportsplex in Brookfield, Nova Scotia. The event was advertized through letters of invitation, electronic notifications and media interviews. Community and business stakeholders were invited to attend the presentation including: municipal politicians, members of regional economic development agencies, leaders of local First Nations communities and organizations. Approximately 30 people from the community attended the presentation which included information on the Project ownership, Project background, reasons for choosing the location, Project schedule, core hole drilling results, commitment to the Project and community, local investment and Project Team. A newsletter with Project updates was distributed at this event (Appendix G). The presentation is available on the Project website.

An open house session was held in the Brookfield Fire Hall from 5 to 8 pm on November 22, 2006. In order to publicize the event, a newsletter was distributed to over 1,200 stakeholders and area residents (Appendix G). The event was also advertized in the Truro Daily News on Saturday November 18th and Sunday November 19th and radio announcements were made on the local radio station on the days leading up to the event (Appendix G). The intent of the open house session was to encourage dialogue between members of the Project Team in attendance and the general public and stakeholders; to enable the public and stakeholders to obtain Project information; to view the proposed Project; and to participate in the environmental assessment process.

The session was informal consisting of: a series of poster storyboards (Appendix G); maps of the Project area; descriptions of the Project components and activities; and regulatory approval processes for the Project. Alton staff and consultants providing expertise on technical, environmental and land use were available to discuss the Project, answer questions, and document and discuss issues related to the Project with interested members of the public. Following the open house, storyboards were placed on the Project website in a downloadable format.

Attendees were asked to sign-in (optional) and were encouraged to complete a feedback form prior to leaving the sessions (Appendix G). One hundred and eight people attended the event. Issues raised at the open house were tracked and are addressed in this Registration document, where appropriate. Issues raised included:

- effect of diluted brine discharge on the Shubenacadie River;
- whether alternatives to discharging diluted brine in the Shubenacadie River had been considered;
- whether local First Nations leadership had been informed of the Project;
- location of the Project with respect to existing buildings/structures and other features;
- opportunities for employment during planning, construction and operations and maintenance of the Project;
- effect of the Project on species at risk, especially the striped bass;
- effect of the diluted brine discharge on downstream flood plain during flooding;
- use of all-terrain vehicle (ATV) on RoW over pipeline;
- potential contamination of well-water;
- level of noise generated by the Project;
- level of construction traffic;
- activities which can be conducted over the pipeline;
- landowner agreement process;
- length of construction period;
- safety of natural gas storage; and
- disturbance of tile drainage in agricultural fields.

Alton will continue to notify the public on the progress of the Project through website updates and a regular newsletter. Ongoing consultations are also being held between the Proponent's land agents and landowners with the location of the right-of-way and pipeline, compensation and land use.

4.2 Aboriginal Involvement

The Mi'kmaq communities of Millbrook and Indian Brook (also referred to as the Shubenacadie First Nation) are nearest to the proposed Project. The Chiefs of each community were invited to the initial Project presentation on October 12, 2006, which is described above. The Chiefs and Councils of each community were also invited to provide input to the environmental assessment (letter in Appendix G).

In order to determine traditional and current uses of the area by each community, Membertou Geomatics Consultants undertook a Mi'kmaq Ecological Knowledge Study (MEKS) (Appendix J) on behalf of the Proponent. This work:

- determines historic and current Mi'kmaq land and resource use in the Project area;
- provides an inventory of plants of significance to the Mi'kmaq in the Project area;
- provides an analysis of potential impacts of the Project on Mi'kmaq land and resource use; and
- provides recommendations for further action or mitigation.

Information from this study is included in Sections 5.10 and 6.7.

4.3 Regulatory Consultation

Consultation with regulatory agencies began with a meeting on August 30, 2006 at the NSEL offices and included representatives from Alton and Jacques Whitford, DFO, NSEL, and the Municipality of Colchester. The purpose of the meeting was to provide general information about the Project, identify and discuss issues and concerns, and discuss the proposed Project schedule and regulatory approvals process.

Additional individual meetings and discussions have been held with various agencies (*e.g.*, DFO, NSDNR, and Environment Canada) to discuss the methodology for collection of Project-specific field data and the assessment of potential impacts on VECs and VSCs.

A summary of the meetings and discussions to date is provided in Table 4.1 below. This consultation effort assists with issues scoping and development of appropriate mitigation for potential adverse effects. These consultations will continue throughout the regulatory approval process for the Project.

TABLE 4.1 Summary of Regulatory Consultation

Regulator(s)	Date	Location	Topics Discussed and Issues Raised
DFO, NSEL, Municipality of Colchester	August 30, 2006	NSEL office, Halifax	▪ overview of Project ▪ supply and market of gas ▪ environmental and socio-economic considerations
DFO	January 24, 2007	BIO, Dartmouth	▪ overview of Project ▪ potential effects and mitigation for fish with particular emphasis on the striped bass
DFO, EC	March 8, 2007	Jacques Whitford Offices	▪ overview of Project ▪ implications of discharge of diluted brine with respect to the *Fisheries Act*.
NSDNR	September 2005	Telephone	▪ overview of Project, field work, and potential effects on flora and fauna.

In addition, comments were received during regulatory review process for the Draft EA document. These comments are presented in a disposition table (Appendix H). Appropriate responses are documented in Appendix H, and where applicable, the EA was modified.

4.4 Relevant Identified Issues

Issues raised throughout the consultation process (*i.e.,* at the open house sessions, meetings with landowners and other stakeholders) have been tracked and are summarized in Table 4.2 along with their status and where the issues are addressed in the EA.

TABLE 4.2 Key Public Issues

Issue	Resolution Status
Effect of brine discharge on the Shubenacadie River	This issue is addressed in Section 6.1.
Exploration of Alternatives to discharging brine into the Shubenacadie	This issue is addressed in Section 2.7.
Informing local First Nations leadership of the Project	This issue is addressed in Sections 4.2 and 6.7.
The location of the Project with respect to existing building/structures and other features	This issue is addressed in Section 6.4. Alton will continue to work with landowners to optimize the location of the pipeline and RoW.
Opportunities for employment during planning, construction and operations and maintenance of the Project.	This issue is addressed in Sections 2.3 and 6.5. As the Project develops, Alton will provide additional information related to employment opportunities to interested parties.
Effect of the Project on species at risk.	This issue is addressed in Section 6.1, 6.2, 6.3.
Effect of the brine discharge on downstream flood plain during flooding.	This issue is addressed in Section 6.4.
Use of all-terrain vehicle (ATV) on RoW over pipeline.	This issue is addressed in Section 6.4.
Potential contamination of well water	This issue is addressed in Sections 3.1 (Table 3.1) and 7.2.
Level of noise generated by the Project.	This issue is addressed in Sections 2.4 and 3.1 (Table 3.1).
Level of construction traffic.	This issue is addressed in Sections 2.1 and 6.4.
Activities which can be conducted over the pipeline.	This issue is addressed in Section 6.4.
Landowner agreement process.	This issue is addressed in Section 6.4.
Length of construction period.	This issue is addressed in Section 2.1.
Safety of natural gas storage.	This issue is addressed in Section 2.5, 7.2.
Disturbance of tile drainage in agricultural fields.	This issue is addressed in Section 6.4.
Effect of water removal from the Shubenacadie River.	This issue is addressed in Section 2.1, 6.1.
Availability of baseline information with respect to the physical properties of the River.	This issue is addressed in Sections 5.3 and 6.1. Alton will begin collecting in-stream salinity data on the Shubenacadie River beginning in the spring of 2007 until late fall 2007.
Presence of impurities within the salt deposit and possible effect on biota in the Shubenacadie River	This issue is addressed in Section 6.1.